United States Court of Appeals

for the Second Circuit

EXHIBITS

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74-2039

IN THE

United States Court of Appeals

FOR THE SECOND CIRCUIT

GENERAL MILLS, INC., a corporation; THE PILLSBURY COMPANY, a corporation; SEABOARD ALLIED MILLING CORPORATION, a corporation,
Plaintiffs-Appellants,

vs.

BETTY FURNESS, Commissioner, Department of Consumer Affairs, City of New York,
Defendant-Appellee.

CIVIL ACTION—ON APPEAL FROM THE FINAL JUDGMENT OF THE UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF NEW YORK

SAT BELOW: HON. C. B. MOTLEY, J.U.S.D.C.

EXHIBITS

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Exhibit P-1

A Study of the Net Weight Changes and Moisture Content of Wheat Flour at Various Relative Humidities

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A STUDY OF THE NET WEIGHT CHANGES AND MOISTURE CONTENT OF WHEAT FLOUR AT VARIOUS RELATIVE HUMIDITIES [1]

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(Received for publication October 7, 1941)

The significance of the moisture content of wheat and wheat products in relation to keeping quality and to changes in weight during storage has stimulated many studies of the changes in moisture content and net weight of such products under different conditions of storage. The majority of the experiments on flour reported in the literature—Willard (1911); Guthrie and Norris (1912); Sanderson (1914, 1915); Swanson, Willard, and Fitz (1915); Stockham (1917); Herman and Hall (1921); Frank and Campbell (1922); Arpin and Pecaud (1923); Frank (1923); Smith and Mitchell (1925); Fairbrother (1929); Thiessen (1933); Krtinsky (1937); Cathcart and Killen (1939), and others—have dealt with variations in net weight and moisture content when flours were exposed to varying influences of the atmosphere as encountered under natural storage conditions for different periods of time. These studies have clearly established that flour, in common with wheat and other cereal products, is hygroscopic, its moisture content fluctuating with changes in the relative humidity of the surrounding atmosphere. Because of its more finely divided state and the method of handling, flour responds more readily to changes in atmospheric humidity than does bulk grain. Small packages exhibit greater and more rapid changes in net weight and moisture content than larger ones when stored under the same conditions. In regard to the influence of the container, Krtinsky (1937) found a greater rate of moisture loss in jute than in paper bags

[1] Paper No. 1930, Scientific Journal Series, Minnesota Agricultural Experiment Station.

but Cathcart and Killen (1939) in studies on flour stored in paper-lined, jute, grain, and cotton bags found that the kind of sack had little effect on the variation in moisture content.

Frank (1923) found that while there was no appreciable difference in the rate of increase in the weight of moisture-free hard and soft winter wheat flours, hard winter wheat flour of normal moisture content retained more moisture than soft winter wheat flour exposed to a dry atmosphere.

In general, the experiments under uncontrolled storage conditions indicate that flour as normally packed will lose weight unless the relative humidity of the atmosphere is in the region of 60% or more. Moreover, the experiments of Fairbrother (1929) have shown that flour subjected to low relative humidities absorbs moisture slowly on re-exposure to high humidity and does not recover all the moisture lost; for example, a flour sample after re-exposure to an original relative humidity of 75% for 17 days failed to recover the weight lost during one night at 40% relative humidity. Fairbrother pointed out that, even at normal temperatures, the drying of flour apparently permanently reduces its hydration capacity. In this connection, Smith and Mitchell (1925) found that flour samples which were oven-dried after exposure to the laboratory atmosphere for 42 hours failed to regain all the weight lost during the drying period upon re-exposure to the laboratory atmosphere.

A few investigators—Bailey (1920); Fairbrother (1929); and Anderson (1937)—have determined the hygroscopic equilibria of flour in atmospheres of controlled relative humidity. Bailey found that the moisture content of patent flour exposed to atmospheres of 30, 50, 70 and 80% relative humidity at 25°C (77°F) contained approximately 5.2, 8.0, 12.1, and 15.0% moisture respectively at equilibrium, the curve representing this relation being parabolic in shape. These results were obtained by exposing 5-gram flour samples in aluminum moisture dishes over aqueous sulfuric acid solutions of the required concentration to provide the desired humidity levels at 25°C and determining the moisture content of the flour, after equilibrium had been attained, by a vacuum oven procedure.

In Fairbrother's (1929) controlled humidity experiments, conducted by exposing flour of 13.1% moisture content (method not stated) at approximately 25°C to air in contact with definite concentrations of sulfuric acid and calculating the equilibrium moisture from the change in weight, a linear relation was found between hygroscopic moisture and relative humidities varying between 15% and 90%. The equilibrium moistures obtained by Fairbrother were much higher than those secured by Bailey; for relative humidities of 30, 50, 70 and 80% Fairbrother found the

hygroscopic moisture to be approximately 9.4, 10.7, 13.8 and 15.5% respectively. Anderson (1937) determined the equilibrium relative humidity of hard winter wheat and wheat stocks by placing samples of varying moisture content in closed containers and reading the relative humidity of the atmosphere over the samples with a Crova hygrometer after equilibrium had been established. His hygroscopic equilibria values for hard winter wheat flour cover the range between 50% and 75% relative humidity; at 50% and 75% relative humidity the equilibrium moistures were 12.9% and 15.4% respectively, which exceed those reported by Fairbrother.

From this brief survey of the literature it is clear that wheat flour is hygroscopic, the rate of change in net weight and moisture content being dependent upon the size of the package and the difference between the moisture content of the flour and the equilibrium moisture corresponding to the existing relative humidity under the storage conditions. There is, however, a distinct lack of agreement regarding the effect of different kinds of containers on the rate at which equilibrium is attained and, of even more importance, in the equilibrium values themselves. The discrepancy between the data reported by Bailey (1920), Fairbrother (1929), and Anderson (1937) may be due to differences in the hydration capacity of the flours used or in the technique employed in determining relative humidity and moisture content. Much of the data on changes in the moisture content of flour under natural storage conditions was obtained prior to the official adoption and widespread use of the vacuum oven and 130°C one-hour air-oven methods for determining the moisture content of cereal products.

These considerations prompted the present investigation, the object of which was to determine as carefully as possible the changes in net weight and moisture content of wheat flour packed in different sizes of paper and cotton sacks and stored under controlled humidity conditions until equilibrium was attained. The large-scale storage tests were supplemented by laboratory studies designed to determine the hygroscopic equilibria of wheat flour over a wider range of humidities than was practical in the large-scale tests and to ascertain the effects of temperature and previous history of the flour in regard to its moisture content on the hygroscopic equilibria values.

Experimental

In order that the results might be of the greatest practical significance an 83% patent flour, commercially milled from a blend of hard red spring and hard winter wheats for the family trade and normally sold in 5, 10, and 24½ pound paper and cotton sacks, was used throughout

the studies. The protein content of the flour was 10.8% and the ash content 0.40%, both expressed on a 13.5% moisture basis.

Large-scale storage tests: For the large-scale storage tests, two similar specially designed heavily insulated cabinets, each with a storage capacity of approximately 47.5 cubic feet and completely air-conditioned for temperature and relative humidity, were made available to us. The wet- and dry-bulb elements of an air-operated recording regulator—the air-output from which operated pneumatic-electric switches which actuated the various pieces of equipment necessary to condition the air to the desired value—were located at the entrance of an external duct which carried the air

TABLE I

DATA SHOWING ACCURACY OF TEMPERATURE AND HUMIDITY CONTROL IN AIR-CONDITIONED STORAGE CABINETS

	Approximate conditions maintained in the cabinet			
	70°F 35% RH	70°F 45% RH	70°F 60% RH	70°F 75% RH
Minimum dry bulb, °F	70	69	70	60
Minimum wet bulb, °F	55	56	61	63
Maximum relative humidity, %	37	43	60	73
Maximum dry bulb, °F	72	71	72	71
Maximum wet bulb, °F	56	58.5	62	64
Minimum relative humidity, %	35	47	58	70
Mean dry bulb, °F	71	70	71	70
Mean relative humidity, %	36	45	59	72

from the cabinet to the conditioner. In order to assure uniform air distribution, the conditioned air was delivered to the cabinet through a distributing device located in the center of the cabinet ceiling. The wet- and dry-bulb thermometers were checked against a thermometer calibrated by the U. S. Bureau of Standards prior to the commencement of the trials.

The accuracy of the humidity control, as computed from a survey of the wet- and dry-bulb temperature records made during the actual storage trials, is indicated by the data recorded in Table I. The accuracy is greater than would at first be expected from the recorded fluctuations of wet- and dry-bulb readings which were fairly large, especially the former. This is due to the fact that, from observation, the minima and maxima of the wet- and dry-bulb readings occurred simultaneously; this is reasonable since an increase or decrease in the dry-bulb temperature also raises or lowers respectively the wet-bulb temperature. As a conservative general statement it may be said that the dry-bulb temperature was

held to within approximately ± 1°F and the relative humidity to within ± 2% to 3%.

It was originally planned to carry out storage trials at a temperature of 70°F (21.1°C) and relative humidities of 30, 45, 60, and 75% respectively; the actual storage conditions, as shown by the mean values recorded in Table I for the lowest and highest humidities, deviated considerably from those originally planned. In the instance of the lowest humidity, the cabinet was actually adjusted to maintain 30% relative humidity and the storage trials were begun; however, because of the limited capacity of the cooling system, it was necessary to readjust the cabinet to a higher relative humidity (36%). As only two cabinets were available the tests at 45% and 72% and those at 36% and 59% relative humidity respectively were made simultaneously.

For the storage tests 5-pound, 10-pound, and 24½-pound paper and cotton sacks were machine packed consecutively from the flour bin feeding the packing machinery. During the packing operation four flour samples were taken at intervals for determination of original moisture content. The cotton sacks were machine sewn, the 10- and 24½-pound paper sacks machine tied, and the 5-pound paper sacks glue-sealed.

For the trials at 45% and 72% relative humidity 16 paper and cotton sacks of each weight (5- and 10-pound) were packed, while 20 of each kind and size were employed for each of the remaining two humidity levels; half of the above samples were used for storage at each relative humidity. Owing to limitations in cabinet space, only two 24½-pound sacks (one paper and one cotton) were stored under each of the four storage conditions. The sacks were numbered consecutively and weighed to the nearest 0.5 gram on a Gurley precision balance (capacity 25 kg on each pan, sensitivity 60 mg at full load). The weights employed were adjusted, and certified by the Minnesota Department of Weights and Measures to fall within the allowable tolerances of the U. S. Bureau of Standards for "Class C Commercial Test Weights" (which are identical with the tolerances established for Class I technical weights in the range of from 1 to 500 grams).

After all the sacks were weighed, an operation which required approximately two hours, the 24½-pound sacks were placed horizontally on the bottom shelf of the storage cabinet. The 5- and 10-pound paper and cotton sacks were placed vertically on the remaining two shelves, their positions being randomized. This procedure not only completely randomized the sacks assigned to the two simultaneous storage conditions and their location within the respective cabinets, but also the order in which the original weights of the sacks assigned to the two cabinets were obtained. The sacks were weighed after three days' storage and

weekly thereafter for the duration of the trials. Each week one 5- and one 10-pound paper sack and one 5- and one 10-pound cotton sack for each storage condition were selected at random and retained for moisture determinations. Immediately after weighing, the contents of the selected sacks were placed in air-tight cans; later, the contents of each can were thoroughly mixed in a small MacLellan batch mixer and four samples removed and placed in air-tight containers. One sample was employed in this laboratory for moisture determinations in triplicate by both the vacuum oven and 130°C one-hour air-oven methods as described in *Cereal Laboratory Methods* (4th ed., 1941) published by the American Association of Cereal Chemists. As a check on our laboratory results, the remaining three samples were distributed to each of three commercial mill laboratories which determined and reported their moisture values in duplicate by the 130°C one-hour air-oven method.

TABLE II

MEAN EMPTY SACK WEIGHTS FOR THE VARIOUS STORAGE CONDITIONS

Kind of sack	Mean empty sack weight			
	36% RH	45% RH	59% RH	72% RH
	g	g	g	g
5-lb paper	20.0	20.5	20.5	21.0
5-lb cotton	17.0	17.0	17.0	17.0
10-lb paper	39.0	39.5	40.0	40.5
10-lb cotton	26.5	26.5	27.0	27.5
24½-lb paper	66.5	67.0	68.0	69.0
24½-lb cotton	50.0	50.0	51.0	52.0

In order to permit the calculation of the net weight of flour in each size and kind of container, twelve 5- and twelve 10-pound empty paper and cotton sacks and five 24½-pound paper and cotton sacks were placed in the storage cabinets maintained at each of the storage conditions and the weights determined after equilibrium was attained. The mean sack weights are recorded in Table II.

Laboratory studies of hygroscopic equilibria at constant temperature: Employing samples of the same flour used in the storage tests, four series of hygroscopic equilibrium determinations were made, each at 10% intervals, over the range from approximately 10% to 80% relative humidity. Three series were conducted at a constant temperature of 25°C (77°F) with the flour adjusted to initial moisture contents of 6.5%, 12.2%, and 14.7% respectively; the remaining series was made at 37°C (98.6°F) with flour at 12.2% moisture. The bulk portion of flour reserved for these studies was not stored in air-tight containers

and was found to contain 12.2% moisture at the time the samples were taken for the laboratory studies. The subsample of 6.5% moisture was secured by exposing a portion of the above sample in the thermostat at 25°C, while the sample at 14.7% moisture content was obtained by exposing another portion over water at a temperature of 2°C. Each of the subsamples was thoroughly mixed in a MacLellan batch mixer and reserved in air-tight containers.

The hygroscopicity was determined by exposing the flour over sulfuric acid solutions in closed vessels placed in an air thermostat equipped with a fan and maintained at the required temperature to within ± 0.1°C. In adjusting the atmospheres to the desired relative humidities, the vapor pressure data of Wilson (1921) for aqueous sulfuric acid solutions were employed.

In order that the flour samples might be weighed at intervals without removing them from the atmospheric conditions to which they were exposed and to lessen the possibility of errors due to creeping of the sulfuric acid solution, a technique similar to that described by Fisher (1927) in his studies of the rate of drying of wheat flour over concentrated sulfuric acid was employed. The humidity chambers consisted of battery jars approximately 5½ × 6⅜ × 10½ inches high. The rim of each jar was ground and fitted with a plate-glass cover 5¾ × 7 inches through the center of which a ½ inch hole was drilled. An aluminum pan equipped with a stirrup was suspended from a nichrome wire passing through the hole of the cover plate, the free end of the wire being formed into a loop. Eight battery jars were placed in a row in the thermostat, the wires passing through small holes drilled in the top of the thermostat and the aluminum pan supported by inserting short glass rods through the loops. A balance from which the left pan was removed was mounted on a drawer track on top of the cabinet. Attached to the left stirrup was a fine nichrome wire which extended through a hole in the bottom of the balance and terminated in a small hook. The balance could thus be brought directly over each of the battery jars. In weighing, the hook was fastened to the loop of the wire supporting the aluminum pan and stirrup (upon which the moisture dishes were placed), and the glass rod removed. When weighing was not in progress, the holes in the top of the cabinet were sealed with small corks and those in the cover plates by two microscope slides each notched on the edge so that they would fit closely around the wire. Stop-cock grease was used to seal the glass joints, care being taken that no grease came in contact with the wire supporting the aluminum pan.

In determining the hygroscopic equilibria, one liter of the required sulfuric acid solution was placed in the battery jar, a 5-g sample of the

flour contained in a standard aluminum moisture dish placed on the supporting aluminum pan, and the jar sealed with the cover plate and microscope slides. Weighings were made at daily intervals until constant weight was attained; in the instance of the lowest humidities, this required approximately two weeks. At the end of each trial, the concentration of the sulfuric acid solution was obtained by determining the density with a Westphal chainomatic balance and the relative humidity computed. The final moisture content of the flour was calculated from a knowledge of the initial moisture content and the change in weight; this procedure was found to give values in excellent agreement with the results obtained by actual determinations of the final moisture contents at equilibrium.

Results of storage trials: In the storage trials irregularities occurred in the tests at 36% and 59% relative humidity. The studies conducted at 36% were commenced with the cabinet adjusted to a relative humidity of 30% but after three days' operation it was found that the capacity of the cooling coil was insufficient to maintain this level against the large quantities of water vapor being contributed by the flour. The initial moisture content of the flour was 13.5% (air-oven method) and from available data it appeared that this level was the approximate equilibrium value for 65% relative humidity. Since a storage cabinet operating at this humidity was temporarily available, the flour sacks were removed from the "30% cabinet," weighed, and transferred to the 65% cabinet in the hope that the weight losses occasioned by three days' storage would be regained, in approximately the same time interval. In the meantime the empty cabinet was readjusted to operate at 36% relative humidity.

The sacks were weighed at intervals over a period of 11 days, when it became obvious from the rate of increase in weight of the 5- and 10-pound sacks that they would not recover their original weight unless stored for a prolonged period, if indeed at all. The 24½-pound sacks, however, more than regained their original weight. Accordingly, one each of the 5- and 10-pound paper and cotton sacks was reserved for a moisture test, and the remainder transferred to the previous cabinet now adjusted to 36% relative humidity. The initial moisture contents of the 5- and 10-pound sacks stored at this humidity level were therefore not uniform and were, as will be shown later, considerably lower than those stored at the other humidity levels.

The irregularity at 59% relative humidity occurred between the eighth and ninth week of storage, three days prior to the weighings for the ninth week and continuing two days thereafter. During this five-day period the mechanism controlling the water sprays failed, with the result that the relative humidity dropped to a low of approximately 44%. The

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TABLE III

Mean Percentage Change in Net Weight of Flour Stored at 70°–71°F (21.1°–21.7°C) for Varying Times in 5-, 10-, and 24½-Pound Paper and Cotton Sacks at Different Relative Humidities

Storage period	Number of sacks[1]	Percentage change in net weight											
		5-lb sacks			10-lb sacks			5- and 10-lb sacks				24½-lb sacks	
		Paper	Cotton	Paper and cotton	Paper	Cotton	Paper and cotton	Paper	Cotton	Paper and cotton	Standard error[2]	Paper	Cotton
days		%	%	%	%	%	%	%	%	%	%	%	%
FLOUR STORED AT 36% RELATIVE HUMIDITY AND 71°F (21.7°C)													
3	9	−1.21	−1.48	−1.34	−1.19	−1.32	−1.25	−1.20	−1.40	−1.30	.082	−1.66	−1.92
7	9	−2.01	−2.40	−2.20	−1.95	−2.1[illegible]	−2.03	−1.98	−2.25	−2.12	.075	−2.28	−2.66
14	8	−2.69	−2.94	−2.81	−2.63	−2.74	−2.69	−2.66	−2.84	−2.75	.086	−2.90	−3.32
21	7	−3.07	−3.23	−3.15	−3.03	−3.16	−3.10	−3.05	−3.20	−3.12	.077	−3.34	−3.75
28	6	−3.29	−3.35	−3.32	−3.27	−3.34	−3.31	−3.28	−3.35	−3.31	.078	−3.65	−4.01
35	5	−3.37	−3.38	−3.37	−3.39	−3.41	−3.40	−3.38	−3.40	−3.39	.083	−3.85	−4.16
42	4	−3.30	−3.23	−3.26	−3.31	−3.34	−3.32	−3.30	−3.28	−3.29	.096	−3.89	−4.15
49	3	−3.35	−3.32	−3.34	−3.39	−3.41	−3.40	−3.37	−3.36	−3.37	.058	−4.00	−4.22
56	2	−3.26	−3.20	−3.24	−3.34	−3.35	−3.35	−3.30	−3.28	−3.29	.092	−4.02	−4.19
63	1	−3.14	−3.23	−3.18	−3.32	−3.33	−3.32	−3.23	−3.28	−3.26	—	−3.98	−4.13
70	1	−3.25	−3.30	−3.28	−3.32	−3.99	−3.66	−3.28	−3.64	−3.46	—	−3.99	−4.12
FLOUR STORED AT 45% RELATIVE HUMIDITY AND 70°F (21.1°C)													
3	8	−0.82	−0.93	−0.87	−0.70	−0.76	−0.73	−0.76	−0.84	−0.80	.048	−0.51	−0.60
7	8	−1.25	−1.32	−1.28	−1.06	−1.19	−1.13	−1.16	−1.26	−1.21	.055	−0.82	−0.97
14	7	−1.59	−1.63	−1.61	−1.42	−1.52	−1.47	−1.50	−1.58	−1.54	.049	−1.14	−1.30
21	6	−1.75	−1.77	−1.76	−1.61	−1.70	−1.65	−1.68	−1.73	−1.71	.036	−1.36	−1.51
28	5	−1.84	−1.84	−1.84	−1.73	−1.77	−1.75	−1.78	−1.80	−1.79	.034	−1.51	−1.63
35	4	−1.92	−1.94	−1.93	−1.84	−1.93	−1.89	−1.88	−1.94	−1.91	.067	−1.64	−1.76
42	3	−2.04	−2.08	−2.06	−1.99	−2.00	−1.99	−2.02	−2.04	−2.03	.027	−1.82	−1.91
49	2	−2.16	−2.18	−2.17	−2.10	−2.10	−2.10	−2.13	−2.14	−2.14	.019	−1.94	−2.03
56	1	−2.14	−2.20	−2.17	−2.14	−2.08	−2.11	−2.14	−2.14	−2.14	—	−2.06	−2.10
63	1	−1.96	−2.02	−1.99	−1.95	−1.87	−1.91	−1.96	−1.94	−1.95	—	−1.97	−1.98
67	1	−1.94	−2.00	−1.97	−1.91	−1.86	−1.88	−1.92	−1.93	−1.93	—	−1.94	−1.95
FLOUR STORED AT 59% RELATIVE HUMIDITY AND 71°F (21.7°C)													
3	10	0.12	0.27	0.20	0.20	0.23	0.22	0.16	0.25	0.21	.028	0.18	0.21
7	10	0.19	0.33	0.26	0.25	0.31	0.28	0.22	0.32	0.27	.037	0.24	0.28
14	9	0.32	0.46	0.39	0.40	0.44	0.42	0.36	0.45	0.40	.028	—	—
21	8	0.19	0.28	0.23	0.30	0.31	0.30	0.24	0.29	0.27	.023	0.31	0.33
28	7	0.10	0.23	0.17	0.19	0.23	0.21	0.15	0.23	0.19	.028	0.25	0.25
35	6	−0.11	0.00	−0.06	0.03	0.04	0.03	−0.04	0.02	−0.01	.018	0.12	0.12
42	5	−0.26	−0.15	−0.20	−0.12	−0.12	−0.12	−0.19	−0.13	−0.16	.019	0.00	−0.02
49	4	−0.08	+0.06	−0.01	+0.03	+0.07	+0.05	−0.02	+0.06	+0.02	.022	0.08	0.10
56	3	−0.16	−0.08	−0.12	−0.04	−0.02	−0.03	−0.09	−0.05	−0.07	.020	0.02	0.03
63	2	−1.49	−1.74	−1.62	−1.25	−1.48	−1.36	−1.37	−1.61	−1.49	.051	−0.85	−1.01
70	1	−0.79	−0.68	−0.74	−0.62	−0.62	−0.62	−0.70	−0.65	−0.68	—	−0.50	−0.54
77	1	−0.66	−0.57	−0.62	−0.48	−0.47	−0.48	−0.57	−0.52	−0.54	—	−0.41	−0.43
FLOUR STORED AT 72% RELATIVE HUMIDITY AND 70°F (21.1°C)													
3	8	0.68	0.94	0.81	0.67	0.77	0.72	0.68	0.86	0.77	.045	0.45	0.57
7	8	1.08	1.34	1.21	1.04	1.17	1.10	1.06	1.25	1.16	.050	0.75	0.92
14	7	1.32	1.51	1.42	1.26	1.38	1.32	1.29	1.44	1.37	.041	1.00	1.14
21	6	1.46	1.63	1.54	1.40	1.52	1.46	1.43	1.57	1.50	.050	1.16	1.29
28	5	1.45	1.60	1.52	1.41	1.50	1.46	1.43	1.55	1.49	.051	1.22	1.31
35	4	1.43	1.60	1.52	1.44	1.52	1.48	1.43	1.56	1.50	.044	1.28	1.38
42	3	1.49	1.66	1.57	1.51	1.58	1.54	1.50	1.62	1.56	.057	1.32	1.42
49	2	1.64	1.78	1.71	1.69	1.73	1.71	1.66	1.76	1.71	.060	1.45	1.55
56	1	1.61	1.69	1.65	1.74	1.68	1.71	1.68	1.68	1.68	—	1.47	1.57
63	1	1.61	1.64	1.62	1.72	1.67	1.70	1.66	1.66	1.66	—	1.48	1.55
67	1	1.62	1.66	1.64	1.73	1.65	1.69	1.68	1.66	1.66	—	1.50	1.56

[1] The values given in this column represent the number of 5- and 10-lb paper and cotton sacks respectively which were weighed at each storage period. Only one 24½-lb sack of each kind was employed.

[2] The values given in this column represent the pooled standard errors (single determination) for all 5- and 10-lb sacks.

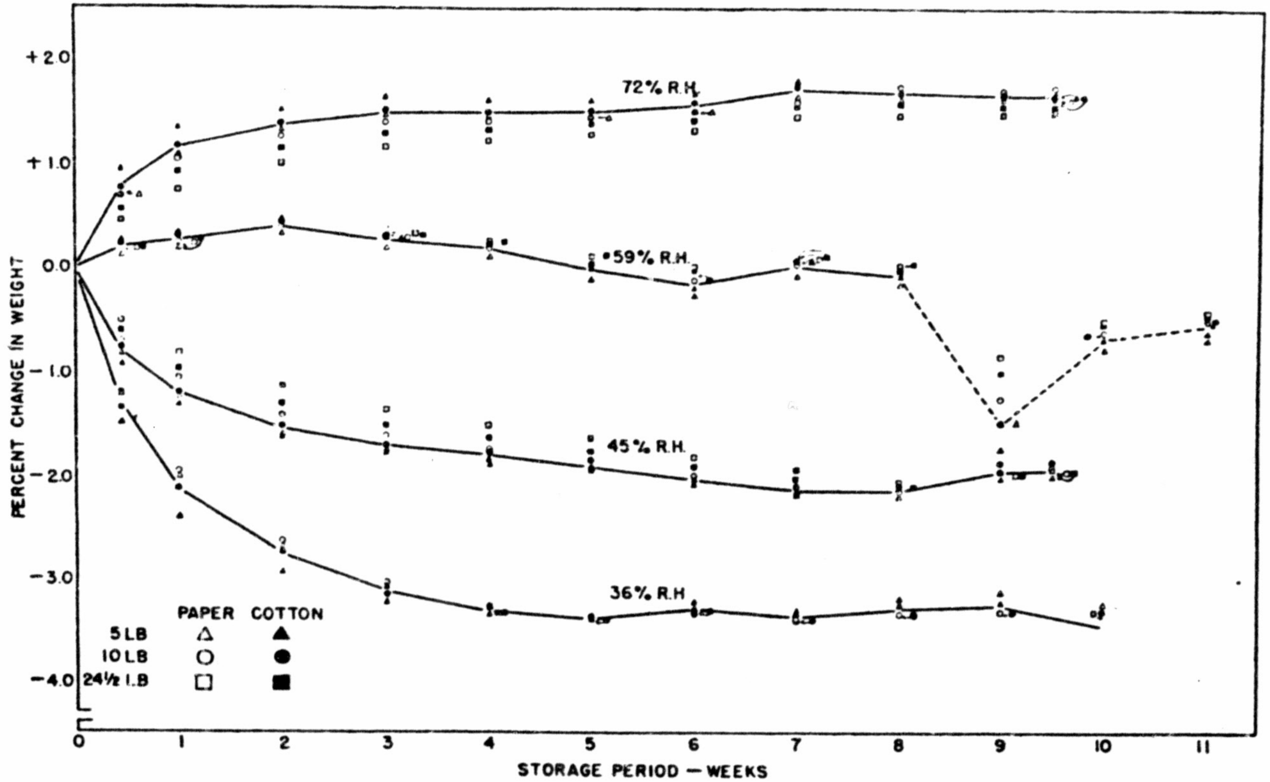

Fig. 1. Mean percentage changes in net weight of flour stored in 5-, 10-, and 24½-pound paper and cotton sacks at 70°–71°F (21.1°–21.7°C) and different relative humidities. (The lines drawn through the scatter of points represent the changes in the mean values for all 5- and 10-pound sacks (paper and cotton) combined. In the storage tests at 59% relative humidity the humidifying apparatus failed three days prior to the weighings for the ninth week and continued for two days thereafter. During this five-day interval the relative humidity fluctuated around 44%.)

humidifying apparatus was repaired during this interval and the storage trials continued for a further two weeks.

The mean percentage changes in net weight of the flour stored in the various sacks for different intervals of time at each of the four humidity levels are recorded in Table III, together with the pooled standard errors (for single determinations) for all 5- and 10-pound sack weight changes at each interval of storage. The percentage changes in weight of the various sizes and kinds of sacks are represented graphically in Figure 1; the lines drawn through the scatter of points represent the mean values for the 5- and 10-pound paper and cotton sacks as recorded in Column 11 of Table III.

The mean results of triplicate determinations of flour moisture content for the various storage conditions are recorded in Tables IV and V.

TABLE IV

MOISTURE CONTENT OF FLOUR STORED AT 70°–71°F (21.1°–21.7°C) IN 5- AND 10-POUND PAPER AND COTTON SACKS FOR VARYING TIMES AT DIFFERENT RELATIVE HUMIDITIES

Storage period	Moisture content[1]								
	5-lb sack			10-lb sack			5- and 10-lb sack		
	Paper	Cotton	Paper and cotton	Paper	Cotton	Paper and cotton	Paper	Cotton	Paper and cotton
days	%	%	%	%	%	%	%	%	%
FLOUR STORED AT 36% RELATIVE HUMIDITY AND 71°F (21.7°C)									
0	12.7	12.6	12.66	12.6	12.8	12.71	12.67	12.70	12.68
7	11.0	10.6	10.78	11.1	11.0	11.07	11.07	10.78	10.92
14	10.5	10.1	10.30	10.6	10.4	10.51	10.57	10.23	10.40
21	10.2	9.9	10.05	10.3	10.0	10.17	10.27	9.95	10.11
28	9.9	9.7	9.82	10.0	9.9	9.94	9.95	9.81	9.88
35	9.8	9.7	9.74	9.8	9.7	9.75	9.81	9.69	9.75
42	9.9	9.9	9.89	10.0	9.9	9.94	9.94	9.89	9.91
49	9.9	9.9	9.86	9.9	9.8	9.89	9.89	9.86	9.87
56	9.9	9.8	9.85	9.9	9.8	9.85	9.90	9.79	9.85
70	9.8	10.0	9.90	9.8	9.8	9.80	9.82	9.88	9.85
FLOUR STORED AT 45% RELATIVE HUMIDITY AND 70°F (21.1°C)									
0	13.3	13.3	13.30	13.3	13.3	13.30	13.30	13.30	13.30
7	12.2	12.0	12.11	12.3	12.1	12.17	12.22	12.05	12.14
14	11.8	11.7	11.78	11.8	11.8	11.83	11.82	11.79	11.80
21	11.7	11.6	11.66	11.8	11.6	11.68	11.75	11.59	11.67
28	11.6	11.5	11.56	11.6	11.5	11.56	11.63	11.49	11.56
35	11.6	11.5	11.53	11.6	11.5	11.58	11.61	11.50	11.55
42	11.4	11.2	11.30	11.3	11.3	11.27	11.31	11.26	11.28
49	11.3	11.3	11.27	11.4	11.3	11.35	11.33	11.29	11.31
67	11.5	11.4	11.43	11.4	11.4	11.42	11.45	11.39	11.42

[1] Air-oven method.

TABLE IV—*Continued*

Storage period	Moisture content[1]								
	5-lb sack			10-lb sack			5- and 10-lb sack		
	Paper	Cotton	Paper and cotton	Paper	Cotton	Paper and cotton	Paper	Cotton	Paper and cotton
days	%	%	%	%	%	%	%	%	%
FLOUR STORED AT 59% RELATIVE HUMIDITY AND 71°F (21.7°C)									
0	13.4	13.4	13.40	13.4	13.4	13.40	13.40	13.40	13.40
7	13.4	13.4	13.41	13.5	13.5	13.48	13.46	13.43	13.44
14	13.5	13.6	13.52	13.5	13.6	13.53	13.48	13.57	13.53
21	13.6	13.6	13.56	13.6	13.6	13.61	13.59	13.58	13.59
28	13.4	13.4	13.43	13.4	13.4	13.44	13.43	13.44	13.43
35	13.4	13.4	13.38	13.3	13.3	13.34	13.36	13.36	13.36
42	13.1	13.2	13.14	13.1	13.1	13.10	13.11	13.12	13.12
49	13.2	13.3	13.24	13.2	13.2	13.24	13.22	13.26	13.24
56	13.2	13.2	13.23	13.2	13.2	13.21	13.22	13.22	13.22
63	12.2	11.8	12.01	12.2	11.9	12.08	12.20	11.89	12.05
77	12.7	12.7	12.70	12.7	12.7	12.70	—	—	—
FLOUR STORED AT 72% RELATIVE HUMIDITY AND 70°F (21.1°C)									
0	13.3	13.3	13.30	13.3	13.3	13.30	13.30	13.30	13.30
7	13.9	14.1	14.01	13.8	13.9	13.86	13.86	14.01	13.93
14	14.1	14.2	14.19	14.1	14.2	14.15	14.12	14.21	14.17
21	14.4	14.4	14.42	14.2	14.3	14.27	14.32	14.37	14.34
28	14.3	14.3	14.31	14.2	14.3	14.24	14.27	14.27	14.27
35	14.3	14.4	14.38	14.4	14.4	14.36	14.35	14.39	14.37
42	14.4	14.5	14.43	14.3	14.2	14.26	14.33	14.36	14.34
49	14.5	14.[illegible]	14.50	14.4	14.6	14.48	14.43	14.55	14.49
67	14.4	14.4	14.41	14.4	14.4	14.40	14.41	14.40	14.41

[1] Air-oven method.

TABLE V

INITIAL AND FINAL MOISTURE CONTENT OF FLOUR STORED IN 24½-POUND PAPER AND COTTON SACKS AT 70°–71°F (21.1°–21.7°C) AND DIFFERENT RELATIVE HUMIDITIES

Time of storage	Storage conditions			Flour moisture content[1]			
	Temperature		Relative humidity	Initial		Final	
				Paper	Cotton	Paper	Cotton
days	°F	°C	%	%	%	%	%
70	71	21.7	36	13.7	13.7	9.9	9.7
67	70	21.1	45	13.3	13.3	11.4	11.4
77	71	21.7	59	13.4	13.4	12.8	12.8
67	70	21.1	72	13.3	13.3	14.2	14.2

[1] Air-oven method.

While moistures were determined in this laboratory by both the vacuum-oven and air-oven methods and in three commercial laboratories, the results were in such excellent general agreement that only the mean air-oven values obtained in this laboratory are presented. For all samples, the air-oven values determined by this laboratory averaged 0.058% lower than for the vacuum-oven method; the experimental errors were virtually identical, the standard error of a single determination being 0.042% for the air-oven and 0.041% for the vacuum-oven method. In the instance of 131 samples, for which strictly comparable air-oven techniques were employed in all four laboratories, the mean moisture obtained by us was 12.163%, and the general mean for the three commercial laboratories was 12.115%. In view of this excellent agreement, it is immaterial, in relation to the general conclusions, as to which moisture data are employed. However, because of its rapidity and convenience the air-oven method is in more general use than the vacuum-oven method in mill laboratories and the results by this procedure were arbitrarily selected for presentation.

With reference to the percentage changes in net weight shown in Table III and Figure 1, it must be recalled that the initial moisture content of the flour stored at 36% relative humidity was not uniform because of the differential response of the various kinds of sacks to the preliminary exposures at 30% and 65% relative humidity. As shown in Tables IV and V, the initial moisture content of the 24½-pound sacks stored at 36% relative humidity was 13.7%, whereas the moisture contents of the 5- and 10-pound sacks ranged between 12.6% and 12.8%. For this reason the data for the 24½-pound sacks have been omitted from Figure 1. The mean initial moisture content of the flour as packed for the storage trials at 45% and 72% relative humidity was 13.3%; for the sacks stored at 59% the mean moisture was 13.4%. These means are based on triplicate determinations made on four samples taken at intervals during packing. Variance analyses revealed that the differences between the moisture contents of the four samples taken during each packing, respectively, were not significant. It can therefore be assumed that the moisture contents for all sacks packed at any one time were identical.

These studies of the percentage changes in weight show that flour responds very readily to changes in relative humidity. The rate of change is relatively rapid during the first few days of storage, the actual rate for any one type of container depending upon the magnitude of the difference between the existing relative humidity and the equilibrium humidity corresponding to the moisture content of the flour.

The initial response to any one set of storage conditions depends upon the size and kind of package. Thus, from Table III and Figure 1

it will be noted that the rate of change in weight decreases with increasing package size and is greater for cotton than for paper sacks; as the storage period is prolonged the cumulative percentage changes in weight for the respective containers tend to equalize. This differential initial response due to the size and kind of sack is most pronounced in the storage trials at 36, 45, and 72% relative humidity where the rate of change is relatively rapid. At 59% relative humidity, the mean rate of change is slow since this humidity level is close to the equilibrium humidity corresponding to the initial moisture content of the flour stored in the 5- and 10-pound sacks. That the differences discussed above are statistically significant has been shown by variance analyses of the data for the 5- and 10-pound sacks for the early storage periods at the different humidity levels; for these periods there was sufficient replication to provide a precise test. The significance of the differences in change in weight of the 5- and 10-pound sacks may also be ascertained by computation from the standard errors for single determinations given in Table III.

The rapidity of the change in weight with changing storage conditions and the differential response of the various sizes and kinds of sacks is perhaps most clearly shown by the data obtained after the failure of the humidity control between the eighth and ninth week of storage at 59% relative humidity. This failure occurred three days before the weighings for the ninth week, the relative humidity rapidly dropping to approximately 44% and fluctuating around this level for five days when the repair was completed. At the eighth week the percentage changes in weights for the different sacks were similar, varying only from + 0.02 to — 0.16%. Upon three days' storage at the lower humidity, the 5-pound cotton sack had decreased 1.74% in weight, the 5-pound paper sack 1.49%, the 10-pound cotton 1.48%, the 10-pound paper 1.25%, the 24½-pound cotton 1.01% and the 24½-pound paper 0.85%. The average cumulative percentage weight change for the 5- and 10-pound paper and cotton sacks was 1.49% or a decrease of 1.42% between the eighth and ninth week. Despite the fact that the repair was completed two days after the weighings for the ninth week, and the sacks re-exposed to 59% relative humidity five days (the same period of time for which they were accidentally exposed to the lower humidity) before the weighings for the tenth week, the average cumulative weight change for the 5- and 10-pound paper and cotton sacks was — 0.68%, a regain of only about 55% of the weight lost. After a further week's storage, there was an additional average regain of only 0.14%. The rate of loss in weight was therefore greater than the rate of regain and the data indicate that the original moisture content would not be reached

except after prolonged storage, if indeed at all. It is of interest to note that the average moisture content for the 5- and 10-pound sacks at the ninth week of storage at 59% relative humidity was 12.05% as compared with 13.22% at the eighth week; thus, the drying of the flour to a 12.0% moisture level apparently altered its hygroscopicity more or less permanently.

The irregularity already mentioned in connection with the storage tests at 36% relative humidity confirms these observations. The weight lost by the 5- and 10-pound sacks in four days at 30% relative humidity was not regained in 11 days' storage at 65%. The original moisture content for all the sacks was 13.4%; upon exposure to 30% and then 65% relative humidity the average moisture content for the 5- and 10-pound sacks was 12.7% and that for the 24½-pound sacks 13.7%. The 24½-pound sacks more than regained their original weight. The reason for this discrepancy in behavior is not clear. While the differential response of the sacks to exposure at 30% relative humidity carried the moisture content of the flour stored in the 5- and 10-pound sacks to a moisture content averaging approximately 0.5% lower than was the case for the 24½-pound sacks, this variation does not appear sufficient to account for the difference in behavior unless the hydration capacity of flour is greatly influenced by relatively slight reductions in moisture content.

Examination of the data given in Table III and Figure 1 does not indicate that any well established equilibrium in net weight has been attained under any of the storage conditions. The behavior of the flour stored at 59% and 72% relative humidity is erratic, particularly at the former level. Careful examination of the wet- and dry-bulb temperature records failed to reveal any trend in the temperature or relative humidity with time of storage which would explain the drifts in the percentage weight changes. Since temperature was held to within 1°F and relative humidity to within 2% to 3%, and the work was carefully performed, it must be concluded that flour is extremely sensitive to slight changes in storage conditions and/or that the hydration capacity of flour varies with time and accordingly, has no precise equilibrium value even under fixed storage conditions.

The moisture data recorded in Table IV for the 5- and 10-pound sacks follow the same general trends as the percentage changes in weight given in Table III. In fact, the moisture content at each storage period may be calculated from a knowledge of the initial moisture content, the initial net weight, and the corresponding weights at each storage period. These computations have been made and the calculated and determined moisture values found to be in good agreement, the maximum discrepancy being 0.3%.

The moisture content of flour packed in 5- and 10-pound sacks changes quite rapidly when stored at relative humidities which differ appreciably from the equilibrium humidity corresponding to the moisture content of the flour, the rate of change decreasing as the moisture content approaches the equilibrium value. For example, during the first week of storage at 36% relative humidity, the moisture content of the flour fell from an initial mean value of 12.68% to 10.92% or a mean loss of 1.76%; in the same interval of time flour containing initially 13.3% moisture lost an average of 1.16% moisture when stored at 45% humidity while it gained 0.63% moisture upon storage at 72% relative humidity. The rate of change in moisture content during the first few

TABLE VI

HYGROSCOPIC EQUILIBRIA OF FLOUR OF VARYING INITIAL MOISTURE CONTENTS AT DIFFERENT RELATIVE HUMIDITIES AND CONSTANT TEMPERATURES [1]

Temperature 25°C						Temperature 37°C	
Initial flour moisture 6.5%		Initial flour moisture 12.2%		Initial flour moisture 14.7%		Initial flour moisture 12.2%	
RH [2]	EM	RH	EM	RH	EM	RH	EM
%	%	%	%	%	%	%	%
10.6	6.1	10.6	5.9	10.9	6.0	12.0	5.5
20.4	7.5	20.6	8.2	20.8	8.1	22.8	7.3
29.6	8.7	29.6	9.5	29.2	9.3	31.0	8.6
39.2	10.1	39.2	11.0	39.1	10.9	40.9	10.1
49.9	11.5	50.0	12.3	49.4	11.9	51.4	11.3
59.2	12.8	59.5	13.2	59.0	13.5	60.5	12.4
68.7	14.1	68.7	14.3	70.4	14.0	69.2	13.6
78.7	15.9	78.8	16.1	78.4	15.8	78.8	15.4

[1] All moisture determinations were carried out by the air-oven method.
[2] RH = relative humidity. EM = equilibrium moisture.

weeks of storage at each of these humidity levels increases with a decrease in the size of the container and is greater for cotton than for paper sacks. In the storage trials at 59% relative humidity, there is no significant differential response due to the size or kind of sack since this humidity level is close to the equilibrium humidity corresponding to the moisture content of the flour, and the rate of change is relatively slow. Statistical analyses of the data for 45%, 59%, and 72% relative humidity confirmed the above observation.[2] For the trials at 45% and 72% humidity, significant interactions were found between storage period and size and kind of sack, and are a reflection of the fact that initially there is a wide differential response of these different sacks to the storage conditions, but as the storage progresses the moisture values tend to

[2] A statistical analysis was not conducted for the 36% humidity level since the moisture contents for the different sacks were not identical at the commencement of the storage period.

approach a common equilibrium independent of the nature or capacity of the sack. Insignificant interactions for size and kind of sack showed that the relative behavior of the flour stored in the 5- and 10-pound sacks is the same whether they are made of paper or cotton.

Results of laboratory determinations of hygroscopic equilibria: The mean results of duplicate determinations of the hygroscopic equilibria of the flour at initial moisture contents of 6.5%, 12.2%, and 14.7%

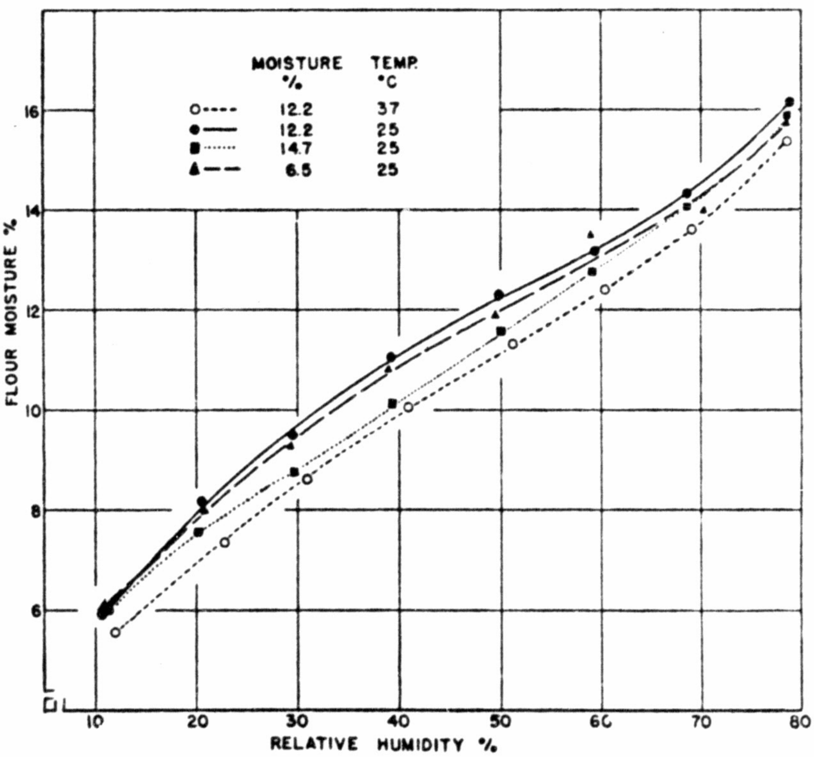

Fig. 2. Hygroscopic equilibria of flour at 25°C (77°F) and 37°C (98.6°F) conditioned to various initial moisture contents.

moisture at various relative humidities are recorded in Table VI and represented graphically in Figure 2. These results show that the hygroscopic equilibrium of a particular flour at any given humidity is not a constant value but depends on its original moisture content and the temperature at which the equilibrium is determined. The lower hygroscopicity of the flour with an initial moisture content of 12.2% determined at 37°C (98.6°F) as compared with 25°C (77°F) would of course be anticipated from the fact that adsorption reactions are characterized by a negative temperature coefficient. The hygroscopicity

values for 25°C (77°F) are not in the order of the original moisture contents of the flour, the sample of 12.2% moisture having the highest and that of 14.7% moisture the lowest hygroscopicity. Whether or not this displacement is due to the conditioning of the high-moisture sample at 2°C (35.6°F) (in order to preclude mold development), whereas the sample at 6.5% was produced by air-drying at room temperature, it is impossible to say but the data indicate that, in common with other biocolloids, relatively minor changes in treatment have an important influence on the hydration capacity of flour. In these experiments, an S-shaped curve best expresses the relationship between relative humidity and hygroscopicity, whereas Bailey (1920) secured curves having the shape of a simple parabola and Fairbrother (1929) found a linear relationship over a similar range in relative humidity. In a theoretical discussion of the water relationships in colloids, Briggs (1931) points out from thermodynamical and other considerations that S-shaped curves are predicated. In the instance of elastic gels at low vapor pressure the adsorption of water by the colloid is of greater importance than the influence of ionic constituents present in the gel; with increasing vapor pressure the adsorptive effect of the colloid becomes relatively insignificant as compared with that due to the effect of the ionic constituents in lowering the vapor pressure. The change in a biocolloid is thus the sum of the water-binding capacity of the colloid itself and of the ions which are present in the mass. In consequence, S-shaped curves result and curves of this type have been reported in the literature for a large number of biocolloids.

Discussion

This study, conducted under carefully controlled conditions, shows that flour responds rapidly to changes in relative humidity and that the rate of loss in moisture greatly exceeds the rate of regain. Substantiation in this regard is afforded by similar observations of Fairbrother (1929), who suggested that even at normal temperatures the drying of flour apparently permanently reduces its hydration capacity. Not only does the apparent hygroscopicity decrease with increasing temperature at which the hydration capacity is determined but even at constant temperature the hygroscopicity of a particular flour at a particular relative humidity is not a definite quantity, but depends upon its past history. In view of our knowledge of the effect of age on the hydrophilic properties of biocolloids, it would furthermore be surprising if a given wheat flour stored at a definite moisture and temperature showed constant hygroscopic equilibria values over any extended period of time. The studies reported in this paper were conducted with only one flour and there is reason to believe that flours of varying chemical composition

under precisely similar conditions of storage would yield different hygroscopic values. The data of Coleman and Fellows (1925), Fairbrother (1929), and Pap (1931) reveal that different wheats show considerable variation in their hygroscopicity and on storage of different wheats of varying moisture content together, equality in moisture content is not attained. In view of these considerations and the differences in experi-

TABLE VII

HYGROSCOPICITY OF WHEAT FLOUR AS REPORTED BY DIFFERENT WORKERS

Relative humidity	Flour moisture content				
	Bailey (1920)	Fairbrother (1929)	Anderson (1937)	Anker, Geddes and Bailey	
				Highest values [1]	Lowest values [2]
%	%	%	%	%	%
30	5.2	9.4	—	9.7	8.5
40	6.5	9.7	—	11.1	9.9
50	8.0	10.7	12.0	12.3	11.1
60	9.8	12.8	13.7	13.2	12.3
70	12.1	14.0	15.4	14.5	13.7
80	15.0	15.7	—	16.3	15.8

[1] Tests at 25°C (77°F) with flour containing 12.2% moisture.
[2] Tests at 37°C (98.6°F) with flour containing 12.2% moisture.

mental technique, it is not surprising that wide discrepancies exist in the hygroscopicity of flour as reported by different workers. The available data known to the authors for selected humidities are summarized in Table VII. Approximate hygroscopic equilibria may also be computed from the storage tests; the best bases for this purpose would appear to be the mean values for the 5- and 10-pound paper sacks for those storage periods where the changes in weight are reasonably stable. These are compiled in Table VIII and compared with the equilibrium

TABLE VIII

COMPARISON OF HYGROSCOPIC EQUILIBRIA FROM STORAGE TESTS ON 5- AND 10-POUND PAPER AND COTTON SACKS AND LABORATORY SCALE STUDIES

Relative humidity	Approximate equilibrium moisture			Storage periods included in computation of second column
	Storage tests at 21.1–21.7°C	Laboratory tests at 25°C, flour at		
		12.2% moisture	14.7% moisture	
%	%	%	%	
36	9.8	10.5	9.7	5 to 10 weeks
45	11.3	11.7	10.9	7 to 9½ weeks
59	13.2	13.1	12.8	5 to 8 weeks
72	14.4	14.7	14.5	5 to 9½ weeks

values determined at 25°C (77°F) for the flours at 12.2% and 14.7% moisture as read from Figure 2. In view of the differences in temperature and original moisture content of the flour in the storage trials and laboratory tests, the agreement is perhaps all that could be expected, with the exception of the values for 36% relative humidity. It will be recalled that the flour used in the storage trials at this humidity level was first exposed to 30% and 65% relative humidity.

The observations made in these studies are of considerable practical significance to millers. Data collected from a large number of mills located in various sections of the United States concerning the moisture content of flour at the time of packing are now being studied in detail

TABLE IX

PERCENTAGE OVERPACKING REQUIRED TO INSURE 100% OF THE REQUIRED WEIGHT AT VARYING RELATIVE HUMIDITIES WITH FLOUR PACKED AT MOISTURE CONTENTS OF 13.0% TO 15.0%

Relative humidity	Flour moisture at equilibrium	Percentage overpacking required to provide full net weight for flours packed at following moisture contents:				
		13.0%	13.5%	14.0%	14.5%	15.0%
%	%	%	%	%	%	%
10	5.9	8.2	8.8	9.4	10.2	10.7
20	8.1	5.6	6.2	6.9	7.6	8.1
30	9.6	3.9	4.5	5.1	5.8	6.4
40	11.1	2.2	2.8	3.4	4.0	4.6
50	12.2	0.9	1.5	2.1	2.7	3.3
60	13.2	−0.2	0.3	0.9	1.5	2.1
70	14.5	−1.7	−1.2	−0.6	0.0	0.6
80	16.5	−4.0	−3.5	−2.9	−2.4	−1.8

to determine the regional and seasonal variations in the moisture content of different types of flour. A survey of the data shows that flours manufactured for the family trade range in moisture content, as milled from approximately 13.0% to 14.0% moisture, the average being probably closer to the higher value. These flours are normally packed in small-sized paper and cotton sacks and hence are extremely susceptible to changes in weight due to atmospheric conditions. If we assume an average moisture content of 13.5% for the flour as packed, our hygroscopicity data indicate that the flour would have to be maintained at a relative humidity of at least 60% to prevent loss in weight. In many districts of the United States the humidity in stores and heated warehouses may fall much below this value for considerable periods, especially in the colder parts of the country during the winter months. The results of our studies and those of Fairbrother (1929) show that moisture will be lost rather rapidly but will be slowly and incompletely re-

gained upon re-exposure to higher humidities, thus likely resulting in a permanent weight loss.

According to the Federal Standards, flour may be packed at moistures up to 15.0% as determined by the vacuum or 130°C air-oven methods. It is therefore of interest to calculate the extent of overpacking flour which would be necessary to ensure 100% of the required weight at varying relative humidities for flours packed at moisture contents of 13.0% to 15.0%. For the purpose of these calculations, which are summarized in Table IX, the highest hygroscopic equilibria values obtained in our studies have been employed, namely those obtained at 25°C with flour at 12.2% initial moisture. These figures are only illustrative. Lower hygroscopicity values would result from exposure at higher temperatures and probably also with increasing age of the flour. In view of the slow rate of regain and the probable permanent reduction in hydration capacity it would be essential, in order to ensure full net weight, to overpack sufficiently to provide for the lowest relative humidity and the highest temperature at which the flour is ever likely to be exposed. This would imply that a large proportion of the flour packed for the family trade would reach the consumer overweight.

Summary

Studies have been conducted of the changes in net weight and moisture content of an 83% patent flour (commercially milled for the family trade from a blend of hard red spring and hard red winter wheats) and containing 13.3% to 13.4% moisture as packed in 5-, 10-, and 24½-pound paper and cotton bags and stored in air-conditioned cabinets maintained at 70°–71°F (21.1°–21.7°C) and relative humidities of 36, 45, 59, and 72% respectively with an accuracy of approximately ± 1°F and 2% to 3% relative humidity.

Rate of change in weight was relatively rapid during the first several days of storage, the actual rate for any one type of container depending upon the magnitude of the difference between the original moisture content of the flour and the moisture content which would finally be attained at the existing relative humidity.

Initial response in weight to any storage condition depended upon the size and kind of package, the rate of change decreasing with the package size and being greater for cotton than for paper sacks. As the storage period was prolonged the cumulative percentage changes in weight for the various containers tended to equalize and approach a common value. No definite equilibrium was obtained even after eight to ten weeks' storage.

Rate of moisture loss on exposure to low relative humidity is much more rapid than the rate of regain; the partial drying of flours even at atmospheric temperatures apparently permanently reduces their hydration capacity.

The approximate moisture equilibria obtained in the storage trials at 70°–71°F (21.1°–21.7°C) for 36, 45, 59, and 72% relative humidity were 9.8, 11.3, 13.2, and 14.4% moisture respectively as determined by the 130°C air-oven method.

Laboratory studies of the hygroscopic equilibria of the same flour brought to initial moistures of 6.5, 12.2, and 14.7% conducted at 25°C (77°F) over the range of 10% to 80% relative humidity revealed that the equilibrium is influenced either by the initial moisture content of the flour or by the environmental conditions to which the flours were exposed during conditioning. Flour at 6.5% moisture had the lowest hygroscopicity and at 12.2% moisture the highest, the differences at corresponding humidities being approximately 1.0%.

Hygroscopic equilibrium of flour at constant relative humidity varies with temperature. Comparative tests at 25°C (77°F) and 37°C (98.6°F) gave differences up to approximately 1.0% at certain humidities.

An S-shaped curve best expressed the relation between relative humidity and hygroscopicity, and is in accord with theoretical considerations of the water relationships of colloids.

A given flour does not possess a definite hygroscopicity, the hydrophilic properties being influenced by its past history.

The practical implications of these studies in relation to the changes in weight of packaged flour are discussed.

Acknowledgment

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CHECKING PREPAC

A Manual for Weights and

NATIONAL BUREAU OF STANDARDS

HANDBOOK 67

U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

CHECKING PREPACKAGED COMMODITIES

A Manual for Weights and Measures Officials

Malcolm W. Jensen

NATIONAL BUREAU OF STANDARDS

HANDBOOK 67

U.S. DEPARTMENT OF COMMERCE • Lewis L. Strauss, Secretary

NATIONAL BUREAU OF STANDARDS • A. V. Astin, Director

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Preface

This publication is the fifth in the series of Handbooks of the National Bureau of Standards designed to present in compact form comprehensive guides for State and local weights and measures officials.

This Handbook presents an operational guide for the control, under law, of prepackaged commodities. It includes information on equipment, techniques, action, reporting, and as an appendix, a comprehensive table that will facilitate the checking of total selling price extensions when these are based on stipulated unit prices.

Authority for such activity on the part of the Bureau is found in basic legislation (64 Stat. 371) wherein the Bureau is authorized to undertake, among others, the following functions: "Cooperation with the States in securing uniformity in weights and measures laws and methods of inspection," and "The compilation and publication of general scientific and technical data resulting from the performance of the functions specified herein or from other sources when such data are of importance to scientific or manufacturing interests or to the general public, and are not available elsewhere * * *."

This Handbook has been published in "pocket" size to further its usefulness to the official and facilitate the adaptation of the price-computation tables to field inspection.

Although the publication has been prepared primarily for use by weights and measures officials of the States, counties, and cities, it is believed that the information presented will be useful to persons employed by commercial and industrial establishments involved in the packing, distributing, and retailing of packaged commodities.

A. V. Astin, *Director.*

Contents

CHECKING PREPACKAGED COMMODITIES

Malcolm W. Jensen

A manual for State and local weights and measures officials, describing a method for controlling various types of prepackaged commodities.

1. INTRODUCTION

There is presented here a method of control of prepackaged commodities (commodities put up in packages in advance of being offered for sale) for use by State and local weights and measures officials—a method based on two concepts:

(1) Variations in quantities of packages are not permitted to such extent that the averages of the quantities in the packages comprising a lot, shipment, or delivery is below the quantity stated, and an unreasonable shortage in any individual package is not acceptable, even though overages in other packages in the same lot, shipment, or delivery compensate for such shortages. (This is the basic quantity requirement of the Model Regulation for Prepackaged Commodities adopted by the National Conference on Weights and Measures and of the Federal Food and Drug Administration.)

(2) Perfection in either mechanical devices or human beings has not yet been attained; thus the existence of imperfection *must* be recognized and allowances for such imperfection must be made. These allowances are recognized in the "average" concept.

2. GENERAL CONSIDERATIONS

The control of the accuracy of quantity in packages is a specialized, yet extremely vital, phase of weights and measures administration.

Obviously the mere assurance of accurate mechanical equipment is only the foundation of weights and measures control, the culmination of which is the assurance of accurate quantity representations to the consumer through official supervision over the use of the weighing and measuring devices.

Special equipment is required for package-quantity checking, and the personnel assigned to this phase of the weights and measures program must receive special training. Although it is not inappropriate to conduct package-checking

procedures in conjunction with and during the store visits made for the primary purpose of scale testing, major efforts in package checking will be most effective if they are separated from other phases of the weights and measures enforcement program. For a sustained program of package checking in a large jurisdiction, it is suggested that the very best results will be obtained if this activity is carried on by trained specialists who concentrate on this type of work.

The inspector assigned principally to mechanical inspections and only as a side line to package checking will normally execute this phase of his work in the retail stores. Occasionally even he will find it advantageous to check packages at wholesale distributors and even, in special circumstances, at the establishment of the manufacturer or packer. The specialist assigned full time to this work will find that much of his activity is carried on at the locations of the distributors and the packers in his jurisdiction. He will "run down" reports of package inaccuracies reported by other inspectors and, on his own initiative, spot-check distributors of packaged merchandise.

The primary object of the inspector in this field is to see that quantity is accurately represented to the ultimate purchaser—the consumer; nevertheless, he may be of very real service to the manufacturer, distributor, and retailer if he is able to identify the exact point at which any shortages begin to appear.

Certain packaged products distributed through the normal packer-to-distributor-to-retailer channel are subject to gain or loss of weight through the increase or decrease in moisture content, beginning immediately after the packaging occurs.

The Model Regulation provides that "variations from the stated weight or measure shall be permitted when caused by ordinary and customary exposure * * * to conditions which normally occur in goood distribution practice and which unavoidably result in change of weight or measure." The distribution point after which such shrinkage losses are permitted is a statutory or regulatory provision that varies among the States.

It is admitted that such indefinites as "ordinary and customary exposure" and "good distribution practice" are difficult to set forth quantitatively; thus the experience and judgment of the inspector must be relied upon. He will learn to compare various environments and various systems of distribution and storage. As the result of his experience he will be able to develop procedures for conducting a sound investigation that will result in the building up of a working knowledge as to what is "customary exposure" and what may be con-

sidered to be "good distribution practice" with respect to the packages of an individual commodity that may gain or lose weight through gain or loss of moisture.

To be truly adequate, a package-checking program must be extensive with respect to the relative time spent, and diversified with respect to the types of packages checked. General coverage of the packages offered for sale in the jurisdiction is the key to adequacy and appropriateness. A program should not be directed to a single type of package, such as fresh meats in self-service markets, or even to a few types. Packages distributed through interstate commerce, canned peas and bottled vinegar, for example, should receive a proportionate share of attention.

Although a weights and measures administrator will direct concentration on specific items for special surveys or to correct quickly faults that have been discovered, he will plan the general program so as to "sample" all areas of commodities sold in packages.

3. CLASSES OF PREPACKAGED COMMODITIES

There are two distinct classes of prepackaged commodities—"random" packages, representing packages of a single commodity in a variety of random sizes which in most cases are put up in the retail store, and "standard-pack" packages, representing packages of a single commodity put up in selected sizes. Within the standard-pack class there are two categories, those packages sold by weight and those sold by liquid measure. Although in certain respects the operations in regard to "random" and "standard-pack" packages differ, the equipment used for the checking and the approach to the checking activity are similar in each case.

4. EQUIPMENT

In the belief that the testing equipment used by a weights and measures official should be, insofar as practicable, "standard" equipment designed especially for and restricted to official use and tested regularly and completely controlled by the official, the procedures described here will, for the most part, involve the use of special equal-arm package-reweighing scales and standard test weights. It is recommended that the first such scale required for this work be one of nominal 3-pound (actual, with careful use, 10-

pound) capacity, with center tower and side bar. The tower should show zero in the center and 1 ounce divided into 1/16 ounce on each side of zero. The side bar also should have zero in the center, with at least 2 ounces divided into 1/8 ounce on each side of zero. The scale should be fitted with locking devices to hold the lever during transit and with a handle for carrying, and should be provided with a protective cover or box.

For the checking of larger packages, such as hams, turkeys, potatoes, apples, and the like, a similar equal-arm scale with capacity of at least 50 pounds is recommended; however, until such a scale is provided, an approved commercial scale in regular use in a market will be satisfactory. Likewise, scales of even larger capacities, platform beam for example, will be used in the checking of 50- and 100-pound bags of produce, feed, seed, and the like. Whenever commercial scales are used by the inspector, the weighing of the packages should be done by the "substitution" method (see 9.1, Step 1 (b), below)—that is, substituting on the scale standard weights in an amount equal to the declared weight of the package and thus using the scale only as an indicator. The commercially used scale should not be used by the inspector for direct readings of package weights.

Standard weights employed by the official during checkweighing procedures may be the same as or similar to those used in testing scales. Normally a total of 30 pounds, with denominations down to 1/16 ounce in the customary system and 0.001 pound in the decimal system, is adequate for small packages, and one 25-pound and two 50-pound test weights will be sufficient for most all large packages. Volumetric measures, ½ pint to 1 gallon (conical with slicker plates) and a 2-ounce cylindrical glass graduate graduated to ½ fluid dram, will be used in checking standard-pack packages sold by liquid measure.

5. POSITION FOR PACKAGE-CHECKING OPERATION

After the announcement of his presence, the official should select a suitable position for his package-checking operations. The principal requirement of the site is convenience—both to the inspector and to the store personnel and customers. If one that is in the customer area of the store yet out of the way of normal customer traffic can be found, it will be quite proper to perform the tasks in the view of the public. This tends to inform the casual onlookers as to one important

phase of the weights and measures program. Such activity also will represent good public relations for the store, if the packages being checked are found to be accurately labeled.

6. SAMPLE SELECTION

(*The word "sample" will be used herein to designate the small group of packages, usually 10, selected to represent a lot, shipment, or delivery.* In a storage area such as is found on the premises of a manufacturer, packer, distributor, and in some cases a retailer, the total inventory of a single item of merchandise in a single size may be found to contain 2 or more lots, each identifiable by a lot symbol. In these instances it is advisable to sample one or more of the individual lots and take action on such individual lot, independent of other lots of the same type package.)

With the location selected, it is advisable to decide, at least tentatively, the lots of prepackaged items that are to be checked (for example, hamburger, chuck roasts, pork chops, calf liver, sliced American cheese, Swiss cheese, cereal, canned beans, salt, and the like) and select the samples from those lots. There are two important considerations in the selection of samples. First, the sample should be of sufficient number to represent properly the lot from which it is taken, yet not so many as to require for a single lot a disproportionate amount of checking time; and second, the samples should be selected from various places in the lot—top, bottom, center, right, left, front, rear—again so that the lot is properly represented. Under normal conditions a sample of 10 will be adequate. A larger sample does not increase the reliability of the sample in an amount proportional to the increase. (An exception in the nature of a larger sample for very large lots is explained in Step 5 of the Checking Procedure, page 9.)

If practicable, all samples should be selected before the weighing of any is begun. This provides for checking the counter "as found," and avoids any possibility of packages being added to or removed from a lot that is to be checked during the time another lot is being checked, and thus disturbing the as-found condition.

7. SCALE TEST

Once the samples have been selected, the scale to be used in the checking procedure is made ready. If the packages are of such size that the equal-arm scale is to be used, the

scale must be placed on a firm support and should be leveled. The scale, itself, should be tested in the new environment. (A simple test is appropriate, such as a careful observation of zero-load indication, one or two equal loads on each pan, one small load to test the tower indicator and side bar, and a test for sensitiveness.) A test not only will assure the inspector that his device is operating properly; it will also convince any observers as to the care exercised by the weights and measures official in the conduct of his duties.

If the packages are large, the store scale that is to be used in the checking should be selected, both as to its physical condition and as to its convenience from the standpoint of the store personnel, and should be examined as to its appropriateness for the checking procedure. Such a scale obviously should be a "sealed" scale. It should be checked carefully for sensitiveness and should be used only if it is sufficiently sensitive to indicate clearly weight in the amount that errors are to be defined. Once the scale has been selected, it should not be released to commercial service until the inspector's use of it has been completed.

8. CHECKING PROCEDURE

8.1. Random Packages (see also Section 9).—The checking procedure is designed to determine whether the average quantity of contents of the packages in a lot is at least equal to the average declared quantity, and also whether there exist any "unreasonably" large errors in the package labeling. This procedure develops such information through the determination of errors in individual packages. The step-by-step procedure for checking random packages follows:

Step 1. Checkweighing.—

(a) Equal-Arm Scale. Weigh each package of the sample representing a single lot by placing on one pan of the scale the package and on the other pan the tare, as represented by similar packaging material (essentially uniform packaging materials having been used for similar packages), and standard weights equal to the declared weight. Read the error as shown on the tower indicator, or tower indicator plus side bar graduations if the error is greater than the tower capacity, to the nearest 1/16 ounce.

(b) "Substitution" Method. First "balance in" on the load-receiving element of the scale to be used, standard weights in small denominations sufficient in total weight to equal the largest plus error that might be expected in the packages to be weighed. Determine carefully the weight

of the packaging material, and then place on the load-receiving element of the scale standard weights in an amount equal to the tare weight plus the labeled weight. Note the exact indication of the scale (either automatically indicated or indicated by poise placement—with or without counter-poise weights—as the case may be). Remove these standard weights from the load-receiving element and place thereon a package to be weighed. Restore precisely the previously noted scale indication by adding or removing standard weights. The weights thus added or removed indicate the package error—*short* (minus) if weights are *added, over* (plus) if weights are *removed.*

Because some shortages in package weight are caused by the leaking of fluids from the commodity, and because certain packages are sufficiently watertight that they will hold such leaked fluid, it will be advisable to make special observation in certain instances. If a package containing a commodity suspected of leaking is transparent, and if any tray, cup, or other absorbent packaging material apparently has not absorbed any moisture, the package may be turned upside down so that any fluid will run to the transparent top and be easily seen. If fluid is apparent inside the package, or if the packaging material appears to be or to have been wet and soggy, the package should be opened and the net weight determined directly.

Step 2. Recording (see also Section 11).—Record the labeled weight and the error in 1/16 ounce for each small package, or in an appropriate denomination for each large package. The zero errors (recorded as 0) and the plus errors are listed in one column, the minus errors in a second column. (See example, Step 5.)

Step 3. Unreasonable errors.—Circle errors that are "unreasonably" large, either plus or minus. The decision as to the unreasonableness of an error, though of necessity arbitrary, must be made and may be predicated, to a certain extent, on knowledge. Consideration should be given to (1) the allowable error in the commercial device employed in the packaging process, (2) the possible error in the scale used to check the packages, (3) anticipated reasonable human errors in both operations, and (4) the susceptibility of the packaged commodity to accurate weight control at the time of packaging. The table that follows is suggested for both random and standard-pack packages that contain items of such a nature that they are susceptible of precise weight control. Standard-pack packages of such commodities as apples, potatoes, and the like cannot be controlled as pre-

cisely as can packages of commodities such as peas, corn, sugar, salt, and flour; consequently the inspector must exercise greater liberality in the determination of the reasonableness or unreasonableness of errors in packages containing large individual elements.

(It will be noted that the suggested plus allowances are twice the suggested minus allowances at each "labeled quantity." This is an acknowledgment that packers must be allowed to overfill such packages as are susceptible of moisture loss.)

UNREASONABLE MINUS OR PLUS ERRORS

Labeled quantity	*Minus error Greater than*	*Plus error Greater than*
0 to 2 ounces	1/8 ounce	1/4 ounce.
2+ to 8 ounces	3/16 ounce	3/8 ounce.
8 ounces+ to 2 pounds	1/4 ounce	1/2 ounce.
2+ to 4 pounds	5/16 ounce	5/8 ounce.
4+ to 7 pounds	3/8 ounce	3/4 ounce.
7+ to 14 pounds	1/2 ounce	1 ounce.
14+ to 24 pounds	3/4 ounce	1½ ounces.
24+ to 36 pounds	1 ounce	2 ounces.
36+ to 51 pounds	8 ounces	1 pound.
51+ to 101 pounds	2 pounds	4 pounds.

The figures offered above are suggested for the determination of the "reasonableness" of errors in individual packages; they should not be used as tolerance figures.

Step 4. Action based on unreasonable errors.—Action should be taken with respect to the packages with unreasonable errors (either + or −); the following is suggested:

(a) If one package of the sample of 10 packages has an unreasonably large *minus* error, that package may be ordered repacked or relabeled, or may be held to constitute a violation of the statute and taken as evidence, at the discretion of the inspector.

(b) If there are in the sample of 10 packages 2 or more packages with unreasonably large *minus* errors, the *entire lot* should be held in violation, *without further calculation.* Appropriate action with respect to ordering off sale, prosecution, or the like should be taken. (See 10. Official Action.)

(c) If 3 or less of the sample of 10 packages have unreasonably large *plus* errors, these should be called to the attention of the market operator or the person responsible.

(d) If there are in the sample of 10 packages 4 or more packages with unreasonably large *plus* errors, this should be considered to show poor packaging practice, without further calculation. This situation should be called to the attention of the store operator, who should be instructed as to more precise weighing.

Step 5. Determination of average error.—Average errors should be determined for those lots on which conclusions have not been reached under (b) and (d) in Step 4 above. The average error is determined as follows:

(a) As in the example below, add the plus (+) errors, on the one hand, and the minus (—) errors, on the other hand—excluding from the sums the circled figures which represent unreasonably large errors. (The unreasonably large errors, both plus and minus, are excluded from the average, because they are acted upon individually and because their inclusion could destroy or alter the packaging "pattern." For example, a sample could show 9 packages each with a minus error of 1/16 ounce and one package with a plus error of 9/16 ounce. If the large plus error is included, the average error is zero. Actually the "pattern" is minus 1/16 ounce per package, and this is evident when the "unreasonably" large plus error is excluded from the average.)

EXAMPLE

Error in 1/16 oz

—	0, +
3	0
1	2
6	0
	2
4	1
	0
	1
	6

(b) Calculate the average error by (1) subtracting the smaller sum (plus errors or minus errors) from the larger sum, (2) giving the result the sign (+ or —) of the larger sum (in the example above: $+6-4=+2$), and (3) dividing the result by the number of items not circled (or the total number of items, including the zeros, included in the sums). Thus, in the example, *average error* = +2/9.

This figure is the number of 16ths ounce that the "average" package of the sample (representing the lot being checked) deviates from zero error, and the sign indicates whether this

average error is plus (overweight) or minus (short weight). This "average" is, of course, exclusive of those packages having unreasonably large errors.

Under many circumstances the inspector will be in a position at this point to declare whether or not the lot under examination conforms to the requirements of the law. In certain instances when a very large lot—say 200 packages or more—is being checked, a further step is advisable. If the average error found in the sample of 10 representing the very large lot is plus, zero, or significantly minus, a decision on the lot is quite proper. If, however, the average error in the sample of 10 representing a very large lot is just barely minus, the inspector will want to convince himself that his small sample is truly representative. In this case 40 more packages should be selected *at random* from the *same* lot. These 40 packages should be weighed individually, the "unreasonably" large errors, plus and minus, circled and eliminated, and an average error calculated for the sample of 50 (the original 10 and the additional 40). Action should be taken on the lot according to the average error on the sample of 50, regardless of the magnitude of such average error.

Although the calculation designated (b) above is not necessary to establish the primary fact that the average net quantity of contents is or is not below the label quantity, this having been established at the conclusion of the computation designated (a), it is well for the inspector to complete the calculation of the average error in order that his report to his superior may be complete, in order that he may properly inform the packer as to the reason for any official action, and so that any record taken to court may be almost self-explanatory. (For action, if average quantity of contents is less than the declared quantity, see 10. Official Action.)

(It is advisable that all calculations made by the inspector be made on the official report form in order that these may be checked for accuracy later in the office.)

8.2. Standard-Pack Packages—Contents Sold by Weight.— The principal difference between the random and standard-pack packages from the standpoint of the checkweighing procedure is in the tare-weight determination. In random packages the tare material normally is readily available to the inspector, and for any random package being checked a duplicate of the packing material can be used on the checking scale to balance out the tare of the package. Obviously such is not the case in standard-pack packages. A procedure for checking standard-pack packages is given below:

Step 1. Weigh *gross* each . the 10 or more packages representing a sample of the same commodity and same type package to identify the *heaviest* and the *lightest* packages, gross weight, and record the gross weight of each.

Step 2. Open the lightest package, exercising care that none of the contents is spilled or lost, and determine the *net* weight of the contents. This can be done either by determining carefully the gross and tare weights and then subtracting the tare from the gross, or by weighing equally carefully the net contents. If the package being weighed is a "wet" commodity and if the label does not indicate the net weight is a "net drained weight," the fluid is part of the net weight and must be considered accordingly.

Step 3. If the net weight of the lightest package *at least equals* the declared net weight, it may be reasonable to assume that the lot is satisfactory.

Step 4. If the net weight of the lightest package *is less than* the declared weight, it will be necessary to treat the 10 packages as a sample of the lot and proceed to weigh them individually to determine individual errors. For this procedure it will be essential to arrive at an average tare weight to be used with the labeled net weight of the contents as the "standard" gross weight with which the package or packages are compared. In order to arrive at a representative average tare weight for the sample, the *heaviest* package must be opened, and the tare weight of this package and of the previously opened lightest package be determined to the nearest $\frac{1}{16}$ ounce. The average of these two tare weights may then be accepted as the tare weight for the weighing of the individual packages. (The inspector is cautioned that the tare of a single package is not considered acceptable as an average tare, and also that no "permanent" or "reference" record of tares is acceptably reliable. The same size can, bottle, or other container may vary significantly in weight over even a reasonably short factory run.)

Step 5. With standard weights in an amount equal to the average tare weight arrived at in Step 4 plus the labeled net weight on one side of the scale (or as the standard weight in the "substitution" procedure if an equal-arm scale is not used), weigh each package of the sample representing the lot and record the errors individually. Exclude, by circling, any errors (+ or −) that are unreasonably large, and determine an average error for the sample (see Steps 1, 2, 3, 4, and 5 of 8.1).

8.3. Standard-Pack Packages—Contents Sold by Liquid Measure.—The most convenient method of determining the accuracy of net-content labeling of packages containing liquids or semisolids and labeled by liquid measure is by weighing the packages. This method offers a rapid control procedure and ould prove satisfactory for enforcement purposes, until . need for court action is indicated. *Any court action must be based on shortages of liquid quantity as determined by standard liquid measure (see Step 7 below).*

The control-by-weight method closely parallels the procedure described in 8.2. for standard-pack packages with contents sold by weight. For simplicity of presentation, a single commodity—fluid milk in 1-quart paper cartons—will be used as the example in the method description that follows:

Step 1. Open 2 cartons of milk and determine precisely (to the nearest 1/32 ounce) the weight of one *measured* quart of the milk that is contained in the cartons under test, by first weighing an empty 1-quart standard measure and then weighing the measure filled with milk. The difference in the two weights will be the weight of one quart of the milk. This will serve as the *net* weight for the checkweighing procedure. If the first carton that is opened contains insufficient milk to fill the standard measure, use milk from the other carton for this purpose. (The correct net weight for the measured volume of milk must be determined for each dairy and for each type of fluid dairy product from a single dairy.)

Step 2. Weigh carefully (to the nearest 1/32 ounce) the empty and dried cartons, from which the milk has been removed, to determine the *average* weight of the empty cartons. This average will serve as the *tare* for the checkweighing procedure. (It may be more convenient to go to each dairy plant that is distributing milk in paper cartons in the jurisdiction and weigh at least 10 cartons of each size and design, selected at random from the available stock. The averages thus obtained can serve as the tares for the checkweighing procedures throughout the jurisdiction. If this system of tare determination is followed, the averages should be checked frequently, because the weights of empty cartons, even from the same manufacturer, will vary somewhat over a period of time.)

Step 3. Select at random a sample of at least 10 cartons of milk of a single grade from a single dairy.

Step 4. Place on one pan of the equal-arm scale standard weights in the amount of the average tare plus the correct net weight of the cartons under test, and on the other pan, one at a time, the cartons of milk to be checked.

Step 5. As in Steps 2, 3, 4, and 5 of 8.1., determine the error in weight, to 1/16 ounce, of each carton of milk, list the zero errors and plus errors in one column and the minus errors in another column, exclude by circling any errors that are unreasonably large, and determine the average error for the sample. (The weight differences between the gross weights of the commercially filled cartons and the correct gross weights—the sum of the correct *net* weight of the measured quantity of milk and the average *tare* weight for the particular carton—represent the errors, over or under, in terms of weight.)

Step 6. If desired, these errors may be converted to liquid measure by determining mathematically the weight of 1 fluid ounce of milk and dividing the weight difference (error) by that figure. Thus, if 1 quart of a particular milk (32 fluid ounces) weighs 34.4 ounces avoirdupois, one fluid ounce weighs 34.4÷32, or 1.08 ounces avoirdupois. Then, if a carton is ½ (0.5) avoirdupois ounce short, it is 0.5÷1.08, or 0.46 fluid ounce short.

Step 7. If the checking of standard-pack packages labeled in terms of liquid measure is to result in prosecution, the actual complaint should be based on determinations of the quantity of contents of the packages by standard liquid measure. This is done by pouring the contents of each of the packages serving as the sample of the lot into a standard liquid measure and, using the small graduated glass standard, measuring carefully the liquid volume necessary to fill the standard or the liquid volume remaining in the carton after the standard has been filled. These shortages and overages are the errors that are to be considered in the determination of unreasonably short packages and of the average error.

9. CHECKING PRICE COMPUTATIONS

A necessary element of random-package checking (in addition to checkweighing) is the checking of selling-price computations. Obviously, even though the declared net weight on a package is accurate, there is involved a "shortage" if the total price shown on the label is greater than such declared weight multiplied by the price per pound.

It is suggested that not all random packages actually checkweighed need be checked for selling-price computations. The inspector should select from the samples that are checkweighed several different commodities, perhaps a high-priced item, a low-priced item, a large package, a small package, and the like, and check the selling-price computations on these. Of the sample of 10 of a single commodity that is

being checkweighed, it should be satisfactory to select 3 or 4 for price-computation checking. If errors are found in these, it will be advisable to check more.

Three methods of checking price computations are suggested.

9.1. Multiplication.—Price computations may be checked without any equipment except a pencil and paper by simply multiplying the declared weight by the price per pound. This process is complicated by the system of labeling in pounds, ounces, and binary submultiples of the ounce. For example, to check the price computation of a package labeled 1 pound 11½ ounces at 69¢ per pound, it is necessary to convert the weight to pounds only; thus 1 pound 11½ ounces $=1\frac{23}{32}$ pounds or $\frac{55}{32}$ or 1.7188 pounds. The correct computation then is 1.7188×0.69 or \$1.19.

9.2. Prepackaging-Scale Computation Chart.—It is possible to use the computing chart of a prepackaging scale to check price computations. When this method is used, a very definite procedure must be followed. The weight indication on the scale must be made to read *exactly* the *labeled weight* of the package being checked. During this process the package is placed on the load-receiving element of the scale to bring the weight indication near to the labeled weight of the package, and then the tare-adjusting mechanism is used to bring the scale weight indication *precisely* to the labeled weight. Once the scale has been so loaded and so adjusted as to bring the weight indication precisely to the labeled weight of the package, the total selling-price computation may be read at the indicated price per pound. The inspector should not place on the scale the net contents of the package or standard weights in an amount equal to the labeled weight of the package and then expect the scale, without tare adjustment, to indicate the correct total selling price of the package. The actual weight of the package or its contents is not of concern in checking the accuracy of the price computation.

9.3. Price Computation Table.—Because the systems described in 9.1 and 9.2 are complicated either by involved mathematical calculations or by inconvenience of physical facility, a third method of checking price computations is offered. This method involves the use of the Price Computation Table presented as an appendix hereto. Through the use of this table, total selling prices may be arrived at either directly, or through very simple addition.

Down the left side of the table the horizontal rows are labeled in weights, from ¼ ounce to 5 pounds by quarter-

ounces and, across the top, the vertical columns are headed in prices per pound, from 1¢ (.01) to 9¢ (.09).

The use of the table is demonstrated in the four examples that follow:

EXAMPLE 1.—2 pounds 10 ounces at 8¢ per pound. (Illustrates procedure for prices per pound less than 10¢.)

Step 1. Locate in the left column the labeled weight—2 pounds 10 ounces.

Step 2. From this horizontal row of figures read directly the figure below the price per pound (.08)—.21000.

Step 3. Round off (see 9.3.1. below) to .21 or 21¢. This is the correct total selling price.

EXAMPLE 2.—1 pound 11½ ounces at 69¢ per pound. (Illustrates procedure for prices per pound of 10¢ (.10) to 99¢ (.99), inclusive.)

Step 1. Locate in the left column the labeled weight—1 pound 11½ ounces.

Step 2. Jot down from this horizontal row of figures the figure below the last digit (9) of the price per pound. This figure is the selling price for 1 pound 11½ ounces at 9¢ per pound (.15469).

Step 3. As 60¢+9¢=69¢, the sum of the figures shown for a given weight at .06 (6¢), when multiplied by 10, plus the figure shown for the same weight at .09 (9¢) is the total selling price for that weight at 69¢ per pound. Thus the figure shown in the row for 1 pound 11½ ounces at .06 per pound (.10312) is multiplied by 10 by moving the decimal point one place to the right and arriving at 1.0312—the selling price for the weight at 60¢ per pound. This is then added to the figure obtained in Step 2:

$ .15469
1.0312
———
$1.18589

Step 4. This sum is rounded off (see 9.3.1. below) to a $1.19, which is the correct selling price for 1 pound 11½ ounces at 69¢ per pound.

EXAMPLE 3.—12¾ ounces at $1.29 per pound. (Illustrates procedure for prices per pound of $1.00 to $9.99, inclusive.)

Steps 1, 2, and 3. The same operations as Steps 1, 2, and 3, Example 2, resulting in .07172 as a selling price at 9¢ per pound and 0.1594 as the selling price at 20¢ per pound.

Step 4. As $1.00+20¢+9¢=$1.29, the indicated price for the stated weight at 1¢ (.01) is multiplied by 100 by moving the decimal point 2 places to the right and arriving at 00.797, the selling price for the weight at $1.00 per pound. This figure is added to the figures obtained in the step above:

$ .07172
0.1594
0.797

$1.02812

Step 5. This figure is rounded off (see 9.3.1 below) to a $1.03, which is the correct total selling price for 12¾ ounces at $1.29 per pound.

EXAMPLE 4.—8 pounds 2 ounces at 89¢ per pound. (Illustrates procedure for packages with labeled weights greater than 5 pounds—the upper limit of the table.)

Step 1. Arrive at the selling price for 2 ounces at 9¢ and at 80¢ as per Example 2, thus

$ .01125
0.1000

Step 2. To these add the product of the price per pound times the number of pounds—$0.89×8=$7.12

$ .01125
0.1000
7.12

$7.23125

Step 3. This is rounded off (see 10.3.1 below) to $7.23, which is the correct total selling price for 8 pounds 2 ounces at 89¢ per pound.

SUMMARY.—As can be seen by the foregoing examples, the table is developed and is used on the very simple decimal system; thus it is possible to have a single series of digits up to 9¢ (.09) per pound, and this series is made to be the equivalent to 90¢ per pound by moving the decimal 1 place to the right and the equivalent of $9.00 per pound by moving the decimal point 2 places to the right. Using 12 ounces as an example, it is seen that

12 ounces at 9¢ per pound = \$0. 06750
12 ounces at 90¢ per pound = 0. 6750
12 ounces at \$9.00 per pound = 6. 750

In this system any zero digits in the price per pound are ignored. The selling price at 80¢ per pound is reached by moving the decimal at 8¢ (.08) one place to the right and then rounding off. At a \$1.09 per pound, the price for the last digit (9) is taken from the table and the price for \$1.00 arrived at by moving the .01 figure two places to the right; these two figures then are added for the total selling price.

9.3.1. Rounding Off.—The figures arrived at through the use of the Price Computation Table must be rounded off to dollars and cents. The following rule is offered as being consistent with commercial practice and reasonable. If the figures to the right of the "cents" represent exactly ½ cent or *more* than ½ cent, round off to the next greater cent. If these figures represent less than ½ cent, round off by dropping them. Thus any figure from .00500 to .00999 would be rounded *up* to .01, and any figure from .00001 to .00499 would be rounded *down* to .00.

10. OFFICIAL ACTION RESULTING FROM PACKAGE CHECKING

10.1. Oral Discussions and Instructions.—Following the completion of the package-checking operations in a particular business establishment, an oral discussion of the results, between the inspector and the person in charge of the establishment, is recommended. Results of the checking should be explained by the inspector, and the information on the report form described. If the samples checked indicate general compliance with the law and regulations, yet there are found inconsistencies in weighing patterns, precision or accuracy less than the inspector is encountering in similar packages by other packers, or any other practices that should receive attention, these should be explained in detail. Many times the inspector will find that his experience will make possible helpful suggestions for the store operator regarding ways and means of increasing accuracy of package labeling.

Oral discussion may also take the form of a "warning" that certain relatively serious conditions that have been found must be corrected.

Any recommendations, instructions, or warnings that are issued orally should be shown in abbreviated form on the official report, as, for example, "oral instructions re: large

overages on packages," "oral instructions re: unnecessary + and — errors," or "warned re: pricing errors." The inference to be drawn from a warning (as distinguished from a recommendation or instruction) is that a continuation of the condition warned against will bring about punitive action by the official.

10.2. Legal Action.—In case the checking procedure discloses (a) one or more packages with unreasonably large minus errors, (b) an average minus error for the entire lot of packages, or (c) significant errors in selling price computations of one or more packages, there will have been demonstrated violation of legal requirements, and the need for punitive action may be indicated.

Legal action may take one or more of several forms, as the law in the particular jurisdiction provides, as per instructions from a superior, and as good judgment dictates: (1) "stop-sale" or "off-sale" orders, which normally provide that the lot cannot be offered for sale until officially released; (2) "reweighing" or "remarking" orders, which provide that an entire lot or individual items from a lot cannot be offered for sale until they have been corrected as to content or labeling (obviously applicable only to random packages, since standard-pack packages no longer would be standard-pack if each were to be remarked with a corrected quantity of contents); or (3) prosecution, in which case it is advisable to purchase or confiscate samples as evidence of the violation.

Whenever legal action is decided upon, this should be described in full on the official report form.

11. REPORT FORM

A suggested Package Checking Report form is shown as figure 1. This form should be printed on letter-size stock in order to provide ample space for the necessary entries and convenience in filing in standard-size facilities.

Under the system proposed, one form would be used for each lot of packages checked, and on the form would be entered relatively complete data concerning that lot.

Each report form should be filled in carefully and should be signed by the inspector. The signature of the business representative to whom any instructions, recommendations, or official information are given should be obtained in the indicated space at the lower right-hand corner of the form and a copy should be left with him. In the case of "chain store" operations, it is suggested that a copy of the report be furnished an immediate superior of the store manager or to another person designated by the company.

Exhibit P-3

Figure 2 illustrates a sample report form filled out for random packages, and figure 3 shows a form covering standard-pack packages.

DEPARTMENT HEADING

PACKAGE CHECKING REPORT

Date ____________

Name ____________ Business ____________

Address ____________

QUANTITY STATEMENT				SELLING PRICE STATEMENT		
Item	Labeled Quantity	Error in ____ −	0, +	Labeled	Computed	Label Error
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
TOTALS						

Commodity

Brand

Packer or Distributor

Address of Packer or Distributor

Price per Unit

$ ________ per ________

Approx. Number in Lot

Tare Wt. - - Standard Pack
Lightest ________
Heaviest ________
Average ________

Equipment Used in Checking

Calculations: ________ ÷ ________ = ________
Total weighing error (+ and − considered) ÷ No. of Pkgs. = Average error in ________

Remarks and/or Instructions: ____________

____
Inspector

Receipt of Report Acknowledged:
____
Business Owner or Operator

FIGURE 1

DEPARTMENT HEADING

PACKAGE CHECKING REPORT

Date 8/3

Name J. Remo, Inc. Business Retail Grocery

Address 4725 H Street

QUANTITY STATEMENT				SELLING PRICE STATEMENT		
Item	Labeled Quantity	Error in 1/16 oz −	0, +	Labeled	Computed	Label Error
1	1lb-2oz	7		$.55		
2	1 - 2½	1		.57	.57	None
3	- 13		0	.40		
4	2 - 1	1		1.01		
5	1 - 10¼		2	.80	.80	None
6	1 - 3		3	.58		
7	1 - 11¾		1	.85		
8	- 10		0	.31	.31	None
9	- 14½	1		.44		
10	1 - 12		2	.86		
11						
12						
13						
14						
15						
TOTALS		3	8			

Commodity: Hamburger

Brand: Own

Packer or Distributor: Self

Address of Packer or Distributor: Same

Price per Unit: $.49 per pound

Approx. Number in Lot: 80

Tare Wt. -- Standard Pack
Lightest ____
Heaviest ____
Average ____

Equipment Used in Checking: 3-lb-Equal Arm

Calculations: +5 (Total weighing error (+ and − considered)) ÷ 9 (No. of Pkgs.) = +5/9 (Average error in 1/16 oz)

+5/9 ÷ 16 = +0.03 oz. Average weighing Error

9)5.000 = .555 (45, 50, 45, 50)   16)555 = .034 (48, 75, 64)

.10406 + 0.4625 = 0.56656   .14766 + 0.6562 = 0.80386   .05625 + 0.2500 = 0.30625

Remarks and/or Instructions: Item 1 ordered remarked

J. Robinson
Inspector

Receipt of Report Acknowledged: H. N. Store
Business Owner or Operator

FIGURE 2

Exhibit P-3

376a

DEPARTMENT HEADING

PACKAGE CHECKING REPORT

Date 8/3

Name J. Remo, Inc. Business Retail Grocery

Address 4725 H Street

QUANTITY STATEMENT				SELLING PRICE STATEMENT		
Item	Labeled Quantity	Error in 1/16 oz —	0, +	Labeled	Computed	Label Error
1	1 pound		1			
2	"		0			
3	"	3				
4	"		0			
5	"	5				
6	"	4				
7	"		1			
8	"	2				
9	"		0			
10	"	2				
11						
12						
13						
14						
15						
TOTALS		16	2			

Commodity: Sugar

Brand: Midnight

Packer or Distributor: Midnight Refiners

Address of Packer or Distributor: 1701 R Street

Price per Unit: $ ——— per ———

Approx. Number in Lot: 170

Tare Wt. - - Standard Pack
Lightest 1 oz.
Heaviest 1 1/2 oz.
Average 1 1/4 oz.

Equipment Used in Checking: 3 lb. - Equal Arm

Calculations: −14 (Total weighing error (+ and − considered)) ÷ 10 (No. of Pkgs.) = −1.4 (Average error in 1/16 oz.)

−1.4 ÷ 16 = −0.09 oz. Average Weighing Error

10)14.0 = 1.4; 10; 40; 40

16)1.4000 = .0875; 128; 120; 112; 80; 80

Remarks and/or Instructions: "Entire lot ordered off Sale"

J. Robinson
Inspector

Receipt of Report Acknowledged:
H. N. Store
Business Owner or Operator

FIGURE 3

Exhibit P-3

APPENDIX

PRICE COMPUTATION TABLE

Lbs.	Ounces	.01	.02	.03	.04	.05	.06	.07	.08	.09
		PRICE PER POUND								
	¼	.00016	.00031	.00047	.00062	.00078	.00094	.00109	.00125	.00141
	½	.00031	.00062	.00094	.00125	.00156	.00188	.00219	.00250	.00281
	¾	.00047	.00094	.00141	.00188	.00234	.00281	.00328	.00375	.00422
	1	.00062	.00125	.00188	.00250	.00312	.00375	.00438	.00500	.00562
	1¼	.00078	.00156	.00234	.00312	.00391	.00469	.00547	.00625	.00703
	1½	.00094	.00188	.00281	.00375	.00469	.00562	.00656	.00750	.00844
	1¾	.00109	.00219	.00328	.00438	.00547	.00656	.00766	.00875	.00984
	2	.00125	.00250	.00375	.00500	.00625	.00750	.00875	.01000	.01125
	2¼	.00141	.00281	.00422	.0056[illegible]	.00703	.00844	.00984	.01125	.01266
	2½	.00156	.00312	.00469	.00625	.00781	.00938	.01094	.01250	.01406
	2¾	.00172	.00344	.00516	.00688	.00859	.01031	.01203	.01375	.01547
	3	.00188	.00375	.00562	.00750	.00938	.01125	.01312	.01500	.01688
	3¼	.00203	.00406	.00609	.00812	.01016	.01219	.01422	.01625	.01828
	3½	.00219	.00438	.00656	.00875	.01094	.01312	.01531	.01750	.01969
	3¾	.00234	.00469	.00703	.00938	.01172	.01406	.01641	.01875	.02109
	4	.00250	.00500	.00750	.01000	.01250	.01500	.01750	.02000	.02250
	4¼	.00266	.00531	.00797	.01062	.01328	.01594	.01859	.02125	.02391
	4½	.00281	.00562	.00844	.01125	.01406	.01688	.01969	.02250	.02531
	4¾	.00297	.00594	.00891	.01188	.01484	.01781	.02078	.02375	.02672
	5	.00312	.00625	.00938	.01250	.01562	.01875	.02188	.02500	.02812
	5¼	.00328	.00656	.00984	.01312	.01641	.01969	.02297	.02625	.02953
	5½	.00344	.00688	.01031	.01375	.01719	.02062	.02406	.02750	.03094
	5¾	.00359	.00719	.01078	.01438	.01797	.02156	.02516	.02875	.03234
	6	.00375	.00750	.01125	.01500	.01875	.02250	.02625	.03000	.03375
	6¼	.00391	.00781	.01172	.01562	.01953	.02344	.02734	.03125	.03516
	6½	.00406	.00812	.01219	.01625	.02031	.02438	.02844	.03250	.03656
	6¾	.00422	.00844	.01266	.01688	.02109	.02531	.02953	.03375	.03797
	7	.00438	.00875	.01312	.01750	.02188	.02625	.03062	.03500	.03938
	7¼	.00453	.00906	.01359	.01812	.02266	.02719	.03172	.03625	.04078
	7½	.00469	.00938	.01406	.01875	.02344	.02812	.03281	.03750	.04219
	7¾	.00484	.00969	.01453	.01938	.02422	.02906	.03391	.03875	.04359
	8	.00500	.01000	.01500	.02000	.02500	.03000	.03500	.04000	.04500
	8¼	.00516	.01031	.01547	.02062	.02578	.03094	.03609	.04125	.04641
	8½	.00531	.01062	.01594	.02125	.02656	.03188	.03719	.04250	.04781
	8¾	.00547	.01094	.01641	.02188	.02734	.03281	.03828	.04375	.04922
	9	.00562	.01125	.01688	.02250	.02812	.0337[illegible]	.03938	.04500	.05062
	9¼	.00578	.01156	.01734	.02312	.02891	.03469	.04047	.04625	.05203
	9½	.00594	.01188	.01781	.02375	.02969	.03562	.04156	.04750	.05344
	9¾	.00609	.01219	.01828	.02438	.03047	.03656	.04266	.04875	.05484
	10	.00625	.01250	.01875	.02500	.03125	.03750	.04375	.05000	.05625
	10¼	.00641	.01281	.01922	.02562	.03203	.03844	.04484	.05125	.05766
	10½	.00656	.01312	.01969	.02625	.03281	.03938	.04594	.05250	.05906
	10¾	.00672	.01344	.02016	.02688	.03359	.04031	.04703	.05375	.06047
	11	.00688	.01375	.02062	.02750	.03438	.04125	.04812	.05500	.06188
	11¼	.00703	.01406	.02109	.02812	.03516	.04219	.04922	.05625	.06328
	11½	.00719	.01438	.02156	.02875	.03594	.04312	.05031	.05750	.06469
	11¾	.00734	.01469	.02203	.02938	.03672	.04406	.05141	.05875	.06609
	12	.00750	.01500	.02250	.03000	.03750	.04500	.05250	.06000	.06750
	12¼	.00766	.01531	.02297	.03062	.03828	.04594	.05359	.06125	.06891
	12½	.00781	.01562	.02344	.03125	.03906	.04686	.05469	.06250	.07031
	12¾	.00797	.01594	.02391	.03188	.03984	.04781	.05578	.06375	.07172

Lbs.	Ounces	PRICE PER POUND .01	.02	.03	.04	.05	.06	.07	.08	.09
	13	.00812	.01625	.02438	.03250	.04062	.04875	.05688	.06500	.07312
	13¼	.00828	.01656	.02484	.03312	.04141	.04969	.05797	.06625	.07453
	13½	.00844	.01688	.02531	.03375	.04219	.05062	.05906	.06750	.07594
	13¾	.00859	.01719	.02578	.03438	.04297	.05156	.06016	.06875	.07734
	14	.00875	.01750	.02625	.03500	.04375	.05250	.06125	.07000	.07875
	14¼	.00891	.01781	.02672	.03562	.04453	.05344	.06234	.07125	.08016
	14½	.00906	.01812	.02719	.03625	.04531	.05438	.06344	.07250	.08156
	14¾	.00922	.01844	.02766	.03688	.04609	.05531	.06453	.07375	.08297
	15	.00938	.01875	.02812	.03750	.04688	.05625	.06562	.07500	.08438
	15¼	.00953	.01906	.02859	.03812	.04766	.05719	.06672	.07625	.08578
	15½	.00969	.01938	.02906	.03875	.04844	.05812	.06781	.07750	.08719
	15¾	.00984	.01969	.02953	.03938	.04922	.05906	.06891	.07875	.08859
1	-------	.01000	.02000	.03000	.04000	.05000	.06000	.07000	.08000	.09000
1	¼	.01016	.02031	.03047	.04062	.05078	.06094	.07109	.08125	.09141
1	½	.01031	.02062	.03094	.04125	.05156	.06188	.07219	.08250	.09281
1	¾	.01047	.02094	.03141	.04188	.05234	.06281	.07328	.08375	.09422
1	1	.01062	.02125	.03188	.04250	.05312	.06375	.07438	.08500	.09562
1	1¼	.01078	.02156	.03234	.04312	.05391	.06469	.07547	.08625	.09703
1	1½	.01094	.02188	.03281	.04375	.05469	.06562	.07656	.08750	.09844
1	1¾	.01109	.02219	.03328	.04438	.05547	.06656	.07766	.08875	.09984
1	2	.01125	.02250	.03375	.04500	.05625	.06750	.07875	.09000	.10125
1	2¼	.01141	.02281	.03422	.04562	.05703	.06844	.07984	.09125	.10266
1	2½	.01156	.02312	.03469	.04625	.05781	.06938	.08094	.09250	.10406
1	2¾	.01172	.02344	.03516	.04688	.05859	.07031	.08203	.09375	.10547
1	3	.01188	.02375	.03562	.04750	.05938	.07125	.08312	.09500	.10688
1	3¼	.01203	.02406	.03609	.04812	.06016	.07219	.08422	.09625	.10828
1	3½	.01219	.02438	.03656	.04875	.06094	.07312	.08531	.09750	.10969
1	3¾	.01234	.02469	.03703	.04938	.06172	.07406	.08641	.09875	.11109
1	4	.01250	.02500	.03750	.05000	.06250	.07500	.08750	.10000	.11250
1	4¼	.01266	.02531	.03797	.05062	.06328	.07594	.08859	.10125	.11391
1	4½	.01281	.02562	.03844	.05125	.06406	.07688	.08969	.10250	.11531
1	4¾	.01297	.02594	.03891	.05188	.06484	.07781	.09078	.10375	.11672
1	5	.01312	.02625	.03938	.05250	.06562	.07875	.09188	.10500	.11812
1	5¼	.01328	.02656	.03984	.05312	.06641	.07969	.09297	.10625	.11953
1	5½	.01344	.02688	.04031	.05375	.06719	.08062	.09406	.10750	.12094
1	5¾	.01359	.02719	.04078	.05438	.06797	.08156	.09516	.10875	.12234
1	6	.01375	.02750	.04125	.05500	.06875	.08250	.09625	.11000	.12375
1	6¼	.01391	.02781	.04172	.05562	.06953	.08344	.09734	.11125	.12516
1	6½	.01406	.02812	.04219	.05625	.07031	.08438	.09844	.11250	.12656
1	6¾	.01422	.02844	.04266	.05688	.07109	.08531	.09953	.11375	.12797
1	7	.01438	.02875	.04312	.05750	.07188	.08625	.10062	.11500	.12938
1	7¼	.01453	.02906	.04359	.05812	.07266	.08719	.10172	.11625	.13078
1	7½	.01469	.02938	.04406	.05875	.07344	.08812	.10281	.11750	.13219
1	7¾	.01484	.02969	.04453	.05938	.07422	.08906	.10391	.11875	.13359
1	8	.01500	.03000	.04500	.06000	.07500	.09000	.10500	.12000	.13500
1	8¼	.01516	.03031	.04547	.06062	.07578	.09094	.10609	.12125	.13641
1	8½	.01531	.03062	.04594	.06125	.07656	.09188	.10719	.12250	.13781
1	8¾	.01547	.03094	.04641	.06188	.07734	.09281	.10828	.12375	.13922
1	9	.01562	.03125	.04688	.06250	.07812	.09375	.10938	.12500	.14062
1	9¼	.01578	.03156	.04734	.06312	.07891	.09469	.11047	.12625	.14203
1	9½	.01594	.03188	.04781	.06375	.07969	.09562	.11156	.12750	.14344
1	9¾	.01609	.03219	.04828	.06438	.08047	.09656	.11266	.12875	.14484
1	10	.01625	.03250	.04875	.06500	.08125	.09750	.11375	.13000	.14625
1	10¼	.01641	.03281	.04922	.06562	.08203	.09844	.11484	.13125	.14766
1	10½	.01656	.03312	.04969	.06625	.08281	.09938	.11594	.13250	.14906
1	10¾	.01672	.03344	.05016	.06688	.08359	.10031	.11703	.13375	.15047

		PRICE PER POUND								
Lbs.	Ounces	.01	.02	.03	.04	.05	.06	.07	.08	.09
1	11	.01688	.03375	.05062	.06750	.08438	.10125	.11812	.13500	.15188
1	11¼	.01703	.03406	.05109	.06812	.08516	.10219	.11922	.13625	.15328
1	11½	.01719	.03438	.05156	.06875	.08594	.10312	.12031	.13750	.15469
1	11¾	.01734	.03469	.05203	.06938	.08672	.10406	.12141	.13875	.15609
1	12	.01750	.03500	.05250	.07000	.08750	.10500	.12250	.14000	.15750
1	12¼	.01766	.03531	.05297	.07062	.08828	.10594	.12359	.14125	.15891
1	12½	.01781	.03562	.05344	.07125	.08906	.10688	.12469	.14250	.16031
1	12¾	.01797	.03594	.05391	.07188	.08984	.10781	.12578	.14375	.16172
1	13	.01812	.03625	.05438	.07250	.09062	.10875	.12688	.14500	.16312
1	13¼	.01828	.03656	.05484	.07312	.09141	.10969	.12797	.14625	.16453
1	13½	.01844	.03688	.05531	.07375	.09219	.11062	.12906	.14750	.16594
1	13¾	.01859	.03719	.05578	.07438	.09297	.11156	.13016	.14875	.16734
1	14	.01875	.03750	.05625	.07500	.09375	.11250	.13125	.15000	.16875
1	14¼	.01891	.03781	.05672	.07562	.09453	.11344	.13234	.15125	.17016
1	14½	.01906	.03812	.05719	.07625	.09531	.11438	.13344	.15250	.17156
1	14¾	.01922	.03844	.05766	.07688	.09609	.11531	.13453	.15375	.17297
1	15	.01938	.03875	.05812	.07750	.09688	.11625	.13562	.15500	.17438
1	15¼	.01953	.03906	.05859	.07812	.09766	.11719	.13672	.15625	.17578
1	15½	.01969	.03938	.05906	.07875	.09844	.11812	.13781	.15750	.17719
1	15¾	.01984	.03969	.05953	.07938	.09922	.11906	.13891	.15875	.17859
2	-------	.02000	.04000	.06000	.08000	.10000	.12000	.14000	.16000	.18000
2	¼	.02016	.04031	.06047	.08062	.10078	.12094	.14109	.16125	.18141
2	½	.02031	.04062	.06094	.08125	.10156	.12188	.14219	.16250	.18281
2	¾	.02047	.04094	.06141	.08188	.10234	.12281	.14328	.16375	.18422
2	1	.02062	.04125	.06188	.08250	.10312	.12375	.14438	.16500	.18562
2	1¼	.02078	.04156	.06234	.08312	.10391	.12469	.14547	.16625	.18703
3	1½	.02094	.04188	.06281	.08375	.10469	.12562	.14656	.16750	.18844
2	1¾	.02109	.04219	.06328	.08438	.10547	.12656	.14766	.16875	.18984
2	2	.02125	.04250	.06375	.08500	.10625	.12750	.14875	.17000	.19125
2	2¼	.02141	.04281	.06422	.08562	.10703	.12844	.14984	.17125	.19266
2	2½	.02156	.04312	.06469	.08625	.10781	.12938	.15094	.17250	.19406
2	2¾	.02172	.04344	.06516	.08688	.10859	.13031	.15203	.17375	.19547
2	3	.02188	.04375	.06562	.08750	.10938	.13125	.15312	.17500	.19688
2	3¼	.02203	.04406	.06609	.08812	.11016	.13219	.15422	.17625	.19828
2	3½	.02219	.04438	.06656	.08875	.11094	.13312	.15531	.17750	.19969
2	3¾	.02234	.04469	.06703	.08938	.11172	.13406	.15641	.17875	.20109
2	4	.02250	.04500	.06750	.09000	.11250	.13500	.15750	.18000	.20250
2	4¼	.02266	.04531	.06797	.09062	.11328	.13594	.15859	.18125	.20391
2	4½	.02281	.04562	.06844	.09125	.11406	.13688	.15969	.18250	.20531
2	4¾	.02297	.04594	.06891	.09188	.11484	.13781	.16078	.18375	.20672
2	5	.02312	.04625	.06938	.90250	.11562	.13875	.16188	.18500	.20812
2	5¼	.02328	.04656	.06984	.09312	.11641	.13969	.16297	.18625	.20953
2	5½	.02344	.04688	.07031	.09375	.11719	.14062	.16406	.18750	.21094
2	5¾	.02359	.04719	.07078	.09438	.11797	.14156	.16516	.18875	.21234
2	6	.02375	.04750	.07125	.09500	.11875	.14250	.16625	.19000	.21375
2	6¼	.02391	.04781	.07172	.09562	.11953	.14344	.16734	.19125	.21516
2	6½	.02406	.04812	.07219	.09625	.12031	.14438	.16844	.19250	.21656
2	6¾	.02422	.04844	.07266	.09688	.12109	.14531	.16953	.19375	.21797
2	7	.02438	.04875	.07312	.09750	.12188	.14625	.17062	.19500	.21938
2	7¼	.02453	.04906	.07359	.09812	.12266	.14719	.17172	.19625	.22078
2	7½	.02469	.04938	.07406	.09875	.12344	.14812	.17281	.19750	.22219
2	7¾	.02484	.04969	.07453	.09938	.12422	.14906	.17391	.19875	.22359
2	8	.02500	.05000	.07500	.10000	.12500	.15000	.17500	.20000	.22500
2	8¼	.02516	.05031	.07547	.10062	.12578	.15094	.17609	.20125	.22641
2	8½	.02531	.05062	.07594	.10125	.12656	.15188	.17719	.20250	.22781
2	8¾	.02547	.05094	.07641	.10188	.12734	.15281	.17828	.20375	.22922

Exhibit P-3

		PRICE PER POUND								
Lbs.	Ounces	.01	.02	.03	.04	.05	.06	.07	.08	.09
2	9	.02562	.05125	.07688	.10250	.12812	.15375	.17938	.20500	.23062
2	9¼	.02578	.05156	.07734	.10312	.12891	.15469	.18047	.20625	.23203
2	9½	.02594	.05188	.07781	.10375	.12969	.15562	.18156	.20750	.23344
2	9¾	02609	.05219	.07828	.10438	.13047	.15656	.18266	.20875	.23484
2	10	.02625	.05250	.07875	.10500	.13125	.15750	.18375	.21000	.23625
2	10¼	.02641	.05281	.07922	.10562	.13203	.15844	.18484	.21125	.23766
2	10½	.02656	.05312	.07969	.10625	.13281	.15938	.18594	.21250	.23906
2	10¾	.02672	.05344	.08016	.10688	.13359	.16031	.18703	.21375	.24047
2	11	.02688	.05375	.08062	.10750	.13438	.16125	.18812	.21500	.24188
2	11¼	.02703	.05406	.08109	.10812	.13516	.16219	.18922	.21625	.24328
2	11½	.02719	.05438	.08156	.10875	.13594	.16312	.19031	.21750	.24469
2	11¾	.02734	.05469	.08203	.10938	.13672	.16406	.19141	.21875	.24609
2	12	.02750	.05500	.08250	.11000	.13750	.16500	.19250	.22000	.24750
2	12¼	.02766	.05531	.08297	.11062	.13828	.16594	.19359	.22125	.24891
2	12½	.02781	.05562	.08344	.11125	.13906	.16688	.19469	.22250	.25031
2	12¾	.02797	.05594	.08391	.11188	.13984	.16781	.19578	.22375	.25172
2	13	.02812	.05625	.08438	.11250	.14062	.16875	.19688	.22500	.25312
2	13¼	.02828	.05656	.08484	.11312	.14141	.16969	.19797	.22625	.25453
2	13½	.02844	.05688	.08531	.11375	.14219	.17062	.19906	.22750	.25594
2	13¾	.02859	.05719	.08578	.11438	.14297	.17156	.20016	.22875	.25734
2	14	.02875	.05750	.08625	.11500	.14375	.17250	.20125	.23000	.25875
2	14¼	.02891	.05781	.08672	.11562	.14453	.17344	.20234	.23125	.26016
2	14½	.02906	.05812	.08719	.11625	.14531	.17438	.20344	.23250	.26156
2	14¾	.02922	.05844	.08766	.11688	.14609	.17531	.20453	.23375	.26297
2	15	.02938	.05875	.08812	.11750	.14688	.17625	.20562	.23500	26438
2	15¼	.02953	.05906	.08859	.11812	.14766	.17719	.20672	.23625	.26578
2	15½	.02969	.05938	.08906	.11875	.14844	.17812	.20781	.23750	.26719
2	15¾	.02984	.05969	.08953	.11938	.14922	.17906	.20891	.23875	.26859
3	---------	.03000	.06000	.09000	.12000	.15000	.18000	.21000	.24000	.27000
3	¼	.03016	.06031	.09047	.12062	.15078	.18094	.21109	.24125	.27141
3	½	.03031	.06062	.09094	.12125	.15156	.18188	.21219	.24250	.27281
3	¾	.03047	.06094	.09141	.12188	.15234	.18281	.21328	.24375	.27422
3	1	.03062	.06125	.09188	.12250	.15312	.18375	.21438	.24500	.27562
3	1¼	.03078	.06156	.09234	.12312	.15391	.18469	.21547	.24625	.27703
3	1½	.03094	.06188	.09281	.12375	.15469	.18562	.21656	.24750	.27844
3	1¾	.03109	.06219	.09328	.12438	.15547	.18656	.21766	.24875	.27984
3	2	.03125	.06250	.09375	.12500	.15625	.18750	.21875	.25000	.28125
3	2¼	.03141	.06281	.09422	.12562	.15703	.18844	.21984	.25125	.28266
3	2½	.03156	.06312	.09469	.12625	.15781	.18938	.22094	.25250	.28406
3	2¾	.03172	.06344	.09516	.12688	.15859	.19031	.22203	.25375	.28547
3	3	.03188	.06375	.09562	.12750	.15938	.19125	.22312	.25500	.28688
3	3¼	.03203	.06406	.09609	.12812	.16016	.19219	.22422	.25625	.28828
3	3½	.03219	.06438	.09656	.12875	.16094	.19312	.22531	.25750	.28969
3	3¾	.03234	.06469	.09703	.12938	.16172	.19406	.22641	.25875	.29109
3	4	.03250	.06500	.09750	.13000	.16250	.19500	.22750	.26000	.29250
3	4¼	.03266	.06531	.09797	.13062	.16328	.19594	.22859	.26125	.29391
3	4½	.03281	.06562	.09844	.13125	.16406	.19688	.22969	.26250	.29531
3	4¾	.03297	.06594	.09891	.13188	.16484	.19781	.23078	.26375	.29672
3	5	.03312	.06625	.09938	.13250	.16562	.19875	.23188	.26500	.29812
3	5¼	.03328	.06656	.09984	.13312	.16641	.19969	.23297	.26625	.29953
3	5½	.03344	.06688	.10031	.13375	.16719	.20062	.23406	.26750	.30094
3	5¾	.03359	.06719	.10078	.13438	.16797	.20156	.23516	.26875	.30234
3	6	.03375	.06750	.10125	.13500	.16875	.20250	.23625	.27000	.30375
3	6¼	.03391	.06781	.10172	.13562	.16953	.20344	.23734	.27125	.30516
3	6½	.03406	.06812	.10219	.13625	.17031	.20438	.23844	.27250	.30656
3	6¾	.03422	.06844	.10266	.13688	.17109	.20531	.23953	.27375	.30797

Lbs.	Ounces	PRICE PER POUND .01	.02	.03	.04	.05	.06	.07	.08	.09
3	7	.03438	.06875	.10312	.13750	.17188	.20625	.24062	.27500	.30938
3	7¼	.03453	.06906	.10359	.13812	.17266	.20719	.24172	.27625	.31078
3	7½	.03469	.06938	.10406	.13875	.17344	.20812	.24281	.27750	.31219
3	7¾	.03484	.06969	.10453	.13938	.17422	.20906	.24391	.27875	.31359
3	8	.03500	.07000	.10500	.14000	.17500	.21000	.24500	.28000	.31500
3	8¼	.03516	.07031	.10547	.14062	.17578	.21094	.24609	.28125	.31641
3	8½	.03531	.07062	.10594	.14125	.17656	.21188	.24719	.28250	.31781
3	8¾	.03547	.07094	.10641	.14188	.17734	.21281	.24828	.28375	.31922
3	9	.03562	.07125	.10688	.14250	.17812	.21375	.24938	.28500	.32062
3	9¼	.03578	.07156	.10734	.14312	.17891	.21469	.25047	.28625	.32203
3	9½	.03594	.01788	.10781	.14375	.17969	.21562	.25156	.28750	.32344
3	9¾	.03609	.07219	.10828	.14438	.18047	.21656	.25266	.28875	.32484
3	10	.03625	.07250	.10875	.14500	.18125	.21750	.25375	.29000	.32625
3	10¼	.03641	.07281	.10922	.14562	.18203	.21844	.25484	.29125	.32766
3	10½	.03656	.07312	.10969	.14625	.18281	.21938	.25594	.29250	.32906
3	10¾	.03672	.07344	.11016	.14688	.18359	.22031	.25703	.29375	.33047
3	11	.03688	.07375	.11062	.14750	.18438	.22125	.25812	.29500	.33188
3	11¼	.03703	.07406	.11109	.14812	.18516	.22219	.25922	.29625	.33328
3	11½	.03719	.07438	.11156	.14875	.18594	.22312	.26031	.29750	.33469
3	11¾	.03734	.07469	.11203	.14938	.18672	.22406	.26141	.29875	.33609
3	12	.03750	.07500	.11250	.15000	.18750	.22500	.26250	.30000	.33750
3	12¼	.03766	.07531	.11297	.15062	.18828	.22594	.26359	.30125	.33891
3	12½	.03781	.07562	.11344	.15125	.18906	.22688	.26469	.30250	.34031
3	12¾	.03797	.07594	.11391	.15188	.18984	.22781	.26578	.30375	.34172
3	13	.03812	.07625	.11438	.15250	.19062	.22875	.26688	.30500	.34312
3	13¼	.03828	.07656	.11484	.15312	.19141	.22969	.26797	.30625	.34453
3	13½	.03844	.07688	.11531	.15375	.19219	.23062	.26906	.30750	.34594
3	13¾	.03859	.07719	.11578	.15438	.19297	.23156	.27016	.30875	.34734
3	14	.03875	.07750	.11625	.15500	.19375	.23250	.27125	.31000	.34875
3	14¼	.03891	.07781	.11672	.15562	.19453	.23344	.27234	.31125	.35016
3	14½	.03906	.07812	.11719	.15625	.19531	.23438	.27344	.31250	.35156
3	14¾	.03922	.07844	.11766	.15688	.19609	.23531	.27453	.31375	.35297
3	15	.03938	.07875	.11812	.15750	.19688	.23625	.27562	.31500	.35438
3	15¼	.03953	.07906	.11859	.15812	.19766	.23719	.27672	.31625	.35578
3	15½	.03969	.07938	.11906	.15875	.19844	.23812	.27781	.31750	.35719
3	15¾	.03984	.07969	.11953	.15938	.19922	.23906	.27891	.31875	.35859
4	--------	.04000	.08000	.12000	.16000	.20000	.24000	.28000	.32000	.36000
4	¼	.04016	.08031	.12047	.16062	.20078	.24094	.28109	.32125	.36141
4	½	.04031	.08062	.12094	.16125	.20156	.24188	.28219	.32250	.36281
4	¾	.04047	.08094	.12141	.16188	.20234	.24281	.28328	.32375	.36422
4	1	.04062	.08125	.12188	.16250	.20312	.24375	.28438	.32500	.36562
4	1¼	.04078	.08156	.12234	.16312	.20391	.24469	.28547	.32625	.36703
4	1½	.04094	.08188	.12281	.16375	.20469	.24562	.28656	.32750	.36844
4	1¾	.04109	.08219	.12328	.14438	.20547	.24656	.28766	.32875	.36984
4	2	.04125	.08250	.12375	.16500	.20625	.24750	.28875	.33000	.37125
4	2¼	.04141	.08281	.12422	.16562	.20703	.24844	.28984	.33125	.37266
4	2½	.04156	.08312	.12469	.16625	.20781	.24938	.29094	.33250	.37406
4	2¾	.04172	.08344	.12516	.16688	.20859	.25031	.29203	.33375	.37547
4	3	.04188	.08375	.12562	.16750	.20938	.25125	.29312	.33500	.37688
4	3¼	.04203	.08406	.12609	.16812	.21016	.25219	.29422	.33625	.37828
4	3½	.04219	.08438	.12656	.16875	.21094	.25312	.29531	.33750	.37969
4	3¾	.04234	.08469	.12703	.16938	.21172	.25406	.29641	.33875	.38109
4	4	.04250	.08500	.12750	.17000	.21250	.25500	.29750	.34000	.38250
4	4¼	.04266	.08531	.12797	.17062	.21328	.25594	.29859	.34125	.38391
4	4½	.04281	.08562	.12844	.17125	.21406	.25688	.29969	.34250	.38531
4	4¾	.04297	.08594	.12891	.17188	.21484	.25781	.30078	.34375	.38672

Exhibit P-3

Lbs.	Ounces	PRICE PER POUND .01	.02	.03	.04	.05	.06	.07	.08	.09
4	5	.04312	.08625	.12938	.17250	.21562	.25875	.30188	.34500	.38812
4	5¼	.04328	.08656	.12984	.17312	.21641	.25969	.30297	.34625	.38953
4	5½	.04344	.08688	.13031	.17375	.21719	.26062	.30406	.34750	.39094
4	5¾	.04359	.08719	.13078	.17438	.21797	.26156	.30516	.34875	.39234
4	6	.04375	.08750	.13125	.17500	.21875	.26250	.30625	.35000	.39375
4	6¼	.04391	.08781	.13172	.17562	.21953	.26344	.30734	.35125	.39516
4	6½	.04406	.08812	.13219	.17625	.22031	.26438	.30844	.35250	.39656
4	6¾	.04422	.08844	.13266	.17688	.22109	.26531	.30953	.35375	.39797
4	7	.04438	.08875	.13312	.17750	.22188	.26625	.31062	.35500	.39938
4	7¼	.04453	.08906	.13359	.17812	.22266	.26719	.31172	.35625	.40078
4	7½	.04469	.08938	.13406	.17875	.22344	.26812	.31281	.35750	.40219
4	7¾	.04484	.08969	.13453	.17938	.22422	.26906	.31391	.35875	.40359
4	8	.04500	.09000	.13500	.18000	.22500	.27000	.31500	.36000	.40500
4	8¼	.04516	.09031	.13547	.18062	.22578	.27094	.31609	.36125	.40641
4	8½	.04531	.09062	.13594	.18125	.22656	.27188	.31719	.36250	.40781
4	8¾	.04547	.09094	.13641	.18188	.22734	.27281	.31828	.36375	.40922
4	9	.04562	.09125	.13688	.18250	.22812	.27375	.31938	.36500	.41062
4	9¼	.04578	.09156	.13734	.18312	.22891	.27469	.32047	.36625	.41203
4	9½	.04594	.09188	.13781	.18375	.22969	.27562	.32156	.36750	.41344
4	9¾	.04609	.09219	.13828	.18438	.23047	.27656	.32266	.36875	.41484
4	10	.04625	.09250	.13875	.18500	.23125	.27750	.32375	.37000	.41625
4	10¼	.04641	.09281	.13922	.18562	.23203	.27844	.32484	.37125	.41766
4	10½	.04656	.09312	.13969	.18625	.23281	.27938	.32594	.37250	.41906
4	10¾	.04672	.09344	.14016	.18688	.23359	.28031	.32703	.37375	.42047
4	11	.04688	.09375	.14062	.18750	.23438	.28125	.32812	.37500	.42188
4	11¼	.04703	.09406	.14109	.18812	.23516	.28219	.32922	.37625	.42328
4	11½	.04719	.09438	.14156	.18875	.23594	.28312	.33031	.37750	.42469
4	11¾	.04734	.09469	.14203	.18938	.23672	.28406	.33141	.37875	.42609
4	12	.04750	.09500	.14250	.19000	.23750	.28500	.33250	.38000	.42750
4	12¼	.04766	.09531	.14297	.19062	.23828	.28594	.33359	.38125	.42891
4	12½	.04781	.09562	.14344	.19125	.23906	.28688	.33469	.38250	.43031
4	12¾	.04797	.09594	.14391	.19188	.23984	.28781	.33578	.38375	.43172
4	13	.04812	.09625	.14438	.19250	.24062	.28875	.33688	.38500	.43312
4	13¼	.04828	.09656	.14484	.19312	.24141	.28969	.33797	.38625	.43453
4	13½	.04844	.09688	.14531	.19375	.24219	.29062	.33906	.38750	.43594
4	13¾	.04859	.09719	.14578	.19438	.24297	.29156	.34016	.38875	.43734
4	14	.04875	.09750	.14625	.19500	.24375	.29250	.34125	.39000	.43875
4	14¼	.04891	.09781	.14672	.19562	.24453	.29344	.34234	.39125	.44016
4	14½	.04906	.09812	.14719	.19625	.24531	.29438	.34344	.39250	.44156
4	14¾	.04922	.09844	.14766	.19688	.24609	.29531	.34453	.39375	.44297
4	15	.04938	.09875	.14812	.19750	.24688	.29625	.34562	.39500	.44438
4	15¼	.04953	.09906	.14859	.19812	.24766	.29719	.34672	.39625	.44578
4	15½	.04969	.09938	.14906	.19875	.24844	.29812	.34781	.39750	.44719
4	15¾	.04984	.09969	.14953	.19938	.24922	.29906	.34891	.39875	.44859
5	--------	.05000	.10000	.15000	.20000	.25000	.30000	.35000	.40000	.45000

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Exhibit P-4A

Mean Monthly Relative Humidity at 7:00 P.M. Compared To Equivalent Indoor Relative Humidity at 70° F

FIGURE 1A. MEAN MONTHLY RELATIVE HUMIDITY AT 7:00 P.M. COMPARED TO EQUIVALENT INDOOR RELATIVE HUMIDITY AT 70° F.
(Data from Central Park, New York City, 1920-1972)

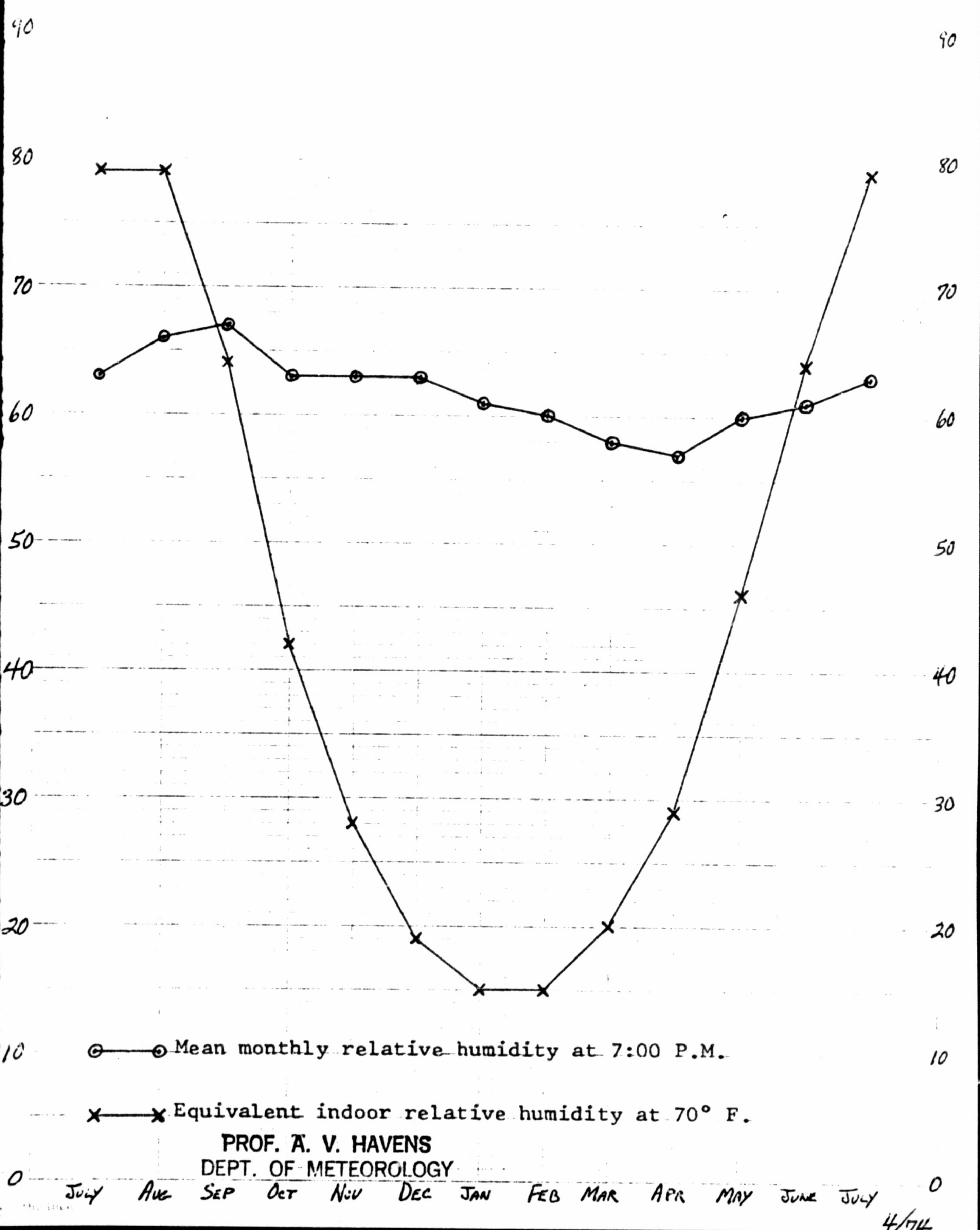

Exhibit P-4B

Mean Monthly Relative Humidity at 1:00 P.M. Compared To Equivalent Indoor Relative Humidity at 70° F

Exhibit P-4B

FIGURE 1. MEAN MONTHLY RELATIVE HUMIDITY AT 1:00 P.M. COMPARED TO EQUIVALENT INDOOR RELATIVE HUMIDITY AT 70° F.
(Data from Central Park, New York City)
1920 - 1972

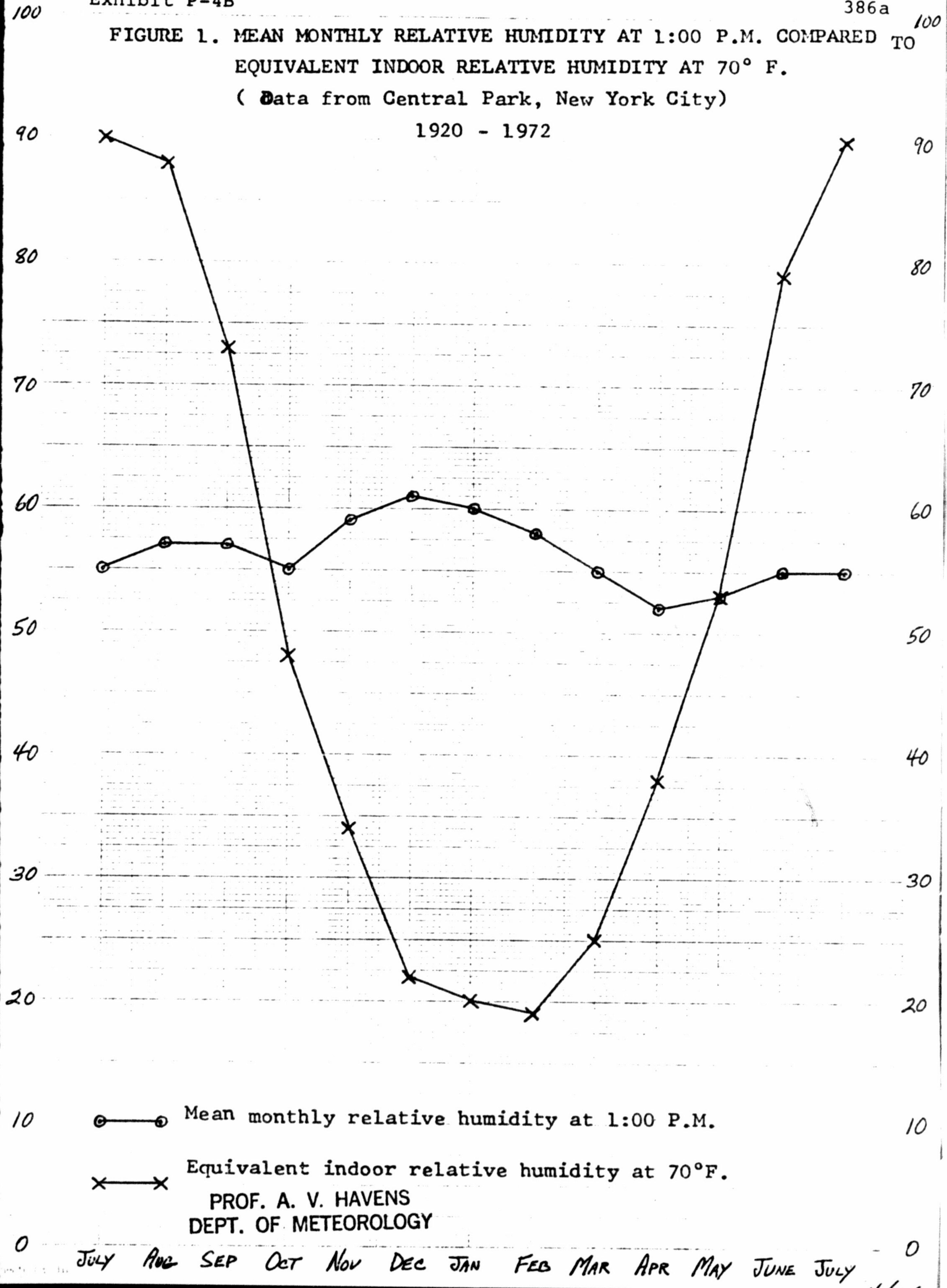

Exhibit P-4C

Mean Annual 1:00 P.M. Relative Humidity At Various Temperatures Compared To Equivalent Indoor Relative Humidity At 70° F

Exhibit P-4C

FIGURE 2. MEAN ANNUAL 1:00 P.M. RELATIVE HUMIDITY AT VARIOUS TEMPERATURES COMPARED TO EQUIVALENT INDOOR RELATIVE HUMIDITY AT 70°F.

(Data from Central Park, New York City, 1920-1972)

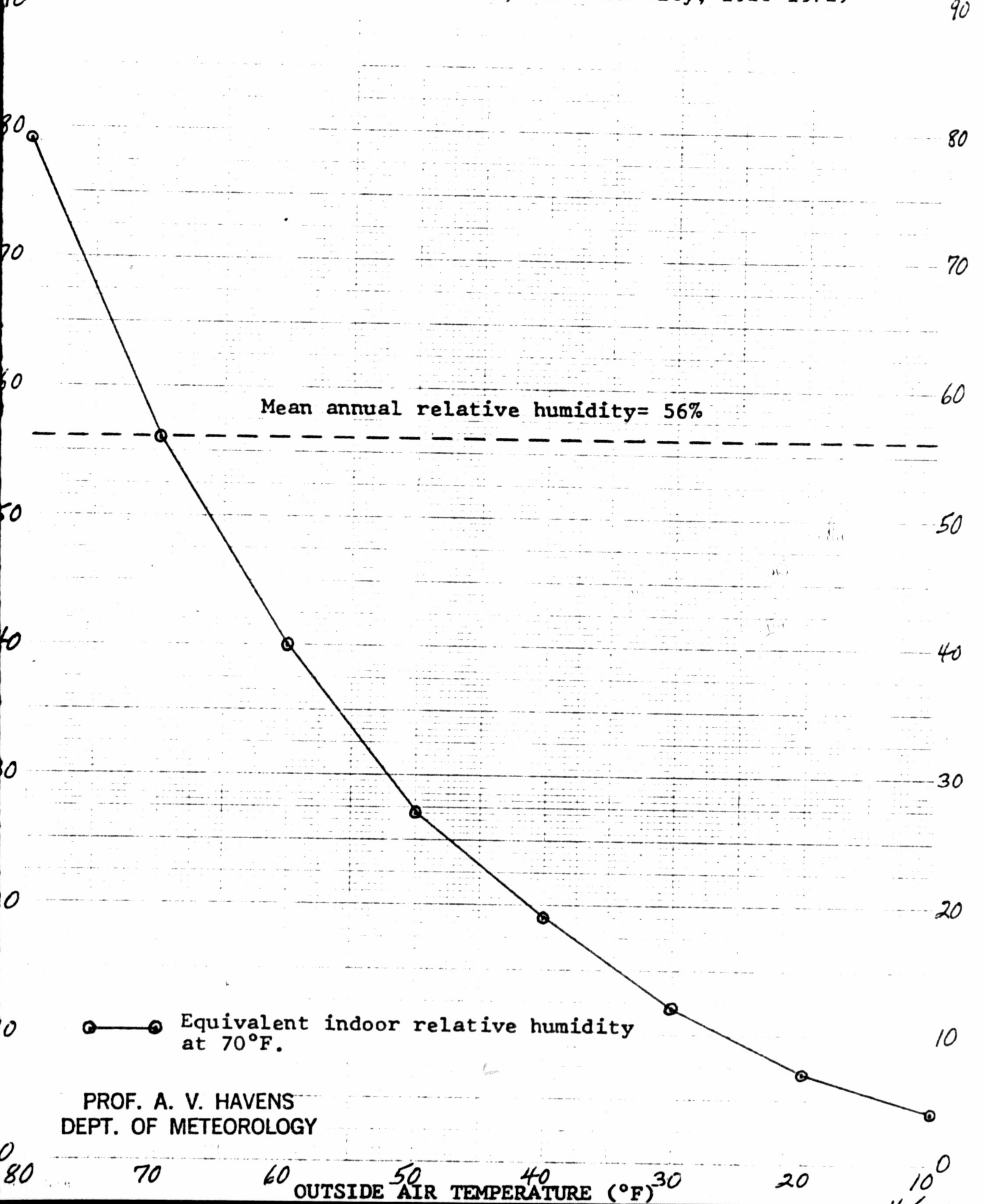

Exhibit P-5

Plaintiff's Request For Admissions

(Printed Supra at P140a)

Exhibit P-6

Statement in Response to Request for Admissions

UNITED STATES DISTRICT COURT FOR THE

SOUTHERN DISTRICT OF NEW YORK

- -x

GENERAL MILLS, INC., a corporation; THE PILLSBURY COMPANY, a corporation; SEABOARD ALLIED MILLING CORPORATION, a corporation,

Plaintiffs,

- against -

BETTY FURNESS, COMMISSIONER, DEPARTMENT OF CONSUMER AFFAIRS, CITY OF NEW YORK,

Defendant.

- -x

73 Civ 2497 (CBM)

Statement in Response to Request for Admissions

Defendant, COMMISSIONER of Consumer Affairs, by her attorney, ADRIAN P. BURKE, Corporation Counsel, makes the following statement in response to plaintiffs' request for admissions served on March 28, 1974.

1. Admits the matter set forth in paragraph "1(a)" on the assumption that the number "15" refers to 15%.

2. Admits that wheat flour is hygroscopic and its moisture content will fluctuate at certain joint or separate changes in the moisture level and temperature in the surrounding atmosphere, but denies that the moisture content of wheat flours necessarily fluctuates at all joint or separate changes in the moisture level and temperature of the surrounding atmospheres as set forth in paragraph "1(b)".

3. Admits the matter set forth in paragraph "1(c)".

4. Denies that all packages of flour will necessarily vary in weight when stored on a grocer's shelf in New York City when the relative humidity is high or low as set forth in paragraph "1(d)", but admits that a package of flour stored on a grocer's shelf may vary in weight depending

on the specific relative humidity, temperature, length of storage and other factors.

5. Objects to the matter set forth in paragraphs "1(e)", "1(f)", "1(g)" and "1(h)" on the ground that such matters as the moisture content, the milling process and the moisture content of flour when produced, the weight control and packaging procedures are immaterial to the only triable issue: whether defendant's application of its shortweight ordinance is an unreasonable burden on irterstate commerce.

6. As to paragraph "1(i)", admits that plaintiffs General Mills, Inc. and The Pillsbury Company stamp a code number on each package of flour and that by referring to the code it is possible for plaintiffs to determine when and where that package of flour was packed, cannot deny or admit what other information the code number contains in that such information is exclusively within the knowledge of plaintiffs and has not been reported to defendant with respect to plaintiffs packages of flour and cannot truthfully admit or deny any matter set forth in paragraph "1(i)" in that plaintiff Seaboard has not alleged the trade name of its flour products.

7. Admits the matter set forth in paragraph "1(j)" except denies that fluctuations due to absorption or evaporation of moisture contents do not affect flour's economic value.

8. Admits the matter set forth in paragraph "1(k) to the extent it repeats the matter set forth in paragraph "1(a)".

9. Cannot admit or deny the matter set forth in paragraph "1(l)" since such matter is within the exclusive knowledge of the plaintiff and notes that plaintiffs' flour packages found to be short-weight may not be subject to federal jurisdiction.

10. Admits matter set forth in paragraph "1(m)".

11. Admits matter set forth in paragraphs "1(n)" and"1(o)" except notes that the packages of flour found by the inspectors were not only less than the stated weight but *prima facie* unreasonably less than the stated net weight.

12. Admits matter set forth in paragraph 1(p).

13. Admits matter set forth in paragraph 1(q) except notes that *prima facie* the packages of flour were found to be unreasonably less than the stated net weight.

14. Denies that the net weight of only 24 of the 25 packages of General Mills' flour were found to be less than the stated net weight and admits that 25 of the packages of General Mills' flour were found to be less than the stated net weight but only 24 of the packages were found to be *prima facie* unreasonably less than the stated net weight.

15. Admits matter set forth in paragraph"1(s)" and notes that defendant's inspectors do not have a duty to make any of the determinations set forth in paragraph "1(s)".

16. Cannot admit nor deny the truthfulness of the matter set forth in paragraph "1(t)"and "1(u)" in that such matter is within the exclusive knowledge of the plaintiff General Mills.

17. Admits matter set forth in paragraph "1(v)" but notes that plaintiff made no claim that the loss of weight was unavoidable and a result of ordinary and customary exposure to conditions that normally occur in distribution practices.

18. Objects to the matter set forth in paragraph "1 (w)" as immaterial and irrelevant to the only triable issue: whether defendant's application of the short-weight ordinance tp plaintiff's package flour imposes an undue burden on interstate commerce.

19. Admits that the documents referred to in paragraphs "2(a)", "2(c)", "2(d)", "2(e)", and "2(f)" are genuine.

20. Cannot admit or deny whether the documents referred to in paragraph "2 (b)", "2(c)", "2(g)", and "2(h)" are genuine.

21. Admits that the document reffered to in paragraph "2(i)" is genuine.

22. Object to the matter referred to in paragraph "3" on the ground that Mr. Jensin's statementsahav immaterial and irrelevant and that the statements made have previously been ruled upon.

ADRIAN P. BURKE
Corporation Counsel of
the City of New York
Attorney for the Defendant
Municipal Building
New York, N.Y. 10007

Renee Modry

RENEE MODRY
Assisting Corporation
Counsel

DEFENDANT'S EXHIBIT "DA"

Defendant's Exhibit "DA", a five-pound package of Gold Medal Flour, is a physical exhibit and is not included. Same is being retained in defendant's possession until called for by the Court.

UNITED STATES COURT OF APPEALS
FOR THE SECOND CIRCUIT

Civil Appeal
Docket No. 74-2039

GENERAL MILLS, INC., a corporation; THE PILLSBURY COMPANY, a corporation; and SEABOARD ALLIED MILLING CORPORATION, a corporation, Plaintiffs-Appellants, vs. BETTY FURNESS, Commissioner, Department of Consumer Affairs, City of New Yo.k, Defendant-Appellee.	:	AFFIDAVIT OF SERVICE

STATE OF NEW JERSEY :
ss.
COUNTY OF ESSEX :

JAMES R. LAMB, being duly sworn, according to law, upon his oath deposes and says:

1. I am an associate with the firm of Carpenter, Bennett & Morrissey, Esqs. who are of counsel to appellants in the above-entitled action.

2. On Thursday, October 10, 1974, I served two copies of Brief of Appellants, one copy of Joint Appendix and one copy of Exhibits on Adrian P. Burke, Esq., Corporation Counsel for the City of New York, Municipal Building, New York, New York 10007, attorney for appellee, by mailing same in a sealed envelope, properly addressed, postage prepaid, Certified Mail, Return Receipt Requested, at the United States Post Office, Woodbridge, New Jersey.

s/ James R. Lamb
James R. Lamb

Sworn and subscribed to before me this 10th day of October, 1974

s/ Patricia M. Kertis
Patricia M. Kertis

UNITED STATES COURT OF APPEALS
FOR THE SECOND CIRCUIT
Civil Appeal Docket # 74-2039

GENERAL MILLS, INC., a corporation; THE PILLSBURY COMPANY, a corporation; and SEABOARD ALLIED MILLING CORPORATION, a corporation,

Plaintiffs-Appellants,

vs.

BETTY FURNESS, Commissioner, Department of Consumer Affairs, City of New York,

Defendant-Appellee.

AFFIDAVIT OF SERVICE

CARPENTER, BENNETT & MORRISSEY
744 Broad Street
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